

Eos, Transactions, American Geophysical Union

Give AGU

your mero addre
Please allow up to 6 weeks for be effected if mailed. Only on needed for AGU membership all AGU subscriptions. Return panel, with label, to:
American Geophysical Union 2000 Florida Avenue, N.W.
Washington, DC 20009

Or, for faster action, call to 800-424-2488; in the Wash DC, area, call 462-6903.

35) Consections Servan Waves and Perricies
ANNULTS FROM THE SEEP ACTIVE SPACE PLANA ENPREDENT:
EFFECTS ON THE IONISPHEN
W. L. Inhof (Lockings File Airo Research Laboratory,
relo Airo, CA 94304), S. S. Celines, B. D. Wose, J. S.
Reagas, b. W. Detfows, J. Mobilis, R. A. Bellimair, U.
S. Incc., J. Karmafratin, and S. O. Jouse
An ecilve estellite-ground roordinated space plains
experienct was conjusted from Hoy to December 1837: in
which clustroam were precipited from the radiation
belts into the inomephere by the controlled injection
of V.F. signals from ground-based treass titles. The
reducts confirm the bypothesis that plactrons one he
precipited from the yealth on helt by ground-based
VIF transmitters and they provide information religing
to the effects of such precipileties on the importhers.
The Lositation vecsus height profiles produced in the
Condephere by the modelland aignals from ground-based

Particles and Fields-

SSOS AITGLOW BIBIS COCKETBORNE SPECTRA OF INVRAPED FLUORESCENCE IS

Division. Air Yorce Geophysics Laboratory, Heracon AFB, Massachuautts (1131)

Righ-residuation (1131)

Righ-residuation (1131) specifial emission data, obrained between 80 and 125 km during an aurora by the rockstone Highs cryogenic interierosater apocitionales, have been analyzed by a specifial similational laboration and the apocition of the second line in the second li

J.P. Matthews | Space Science Ospartten; of tSA/ESIEC,

l. Geophys. Ras., A. Paper 4A1292

wints Colectionne vector of inverse Priorescence ( THE O<sub>1</sub>10.) BAND HAR 100 km M.T. Bawlins and G.E. Caledonia (Physical Scionces Inc. Besseth Part. P.O. Sow 1100. Andover, Russachusetts 01510) (.f. Gibbon and A.T. Stair, Jr. Hintared Technology Division. Air Yorke Goophysics Laboratory, Hanacom

Ionosphere

Vol. 65, No. 48, Pages 1193-1200

November 27, 1984

VLF transpirture are presented along with representa-tive prolline associated with maturally errurring electron pracripitation events. In respection to the strongest transmitter event observed on 17 August 1982, the ionizetion produced by naturally occurring allowing the implestion produced by naturelly occurring electron precipitation can be outh larger or such enaller. Red. Sci., Paper 451711

MAG. 561., Paper 44[17]

5440 log densities and issperatures
10MCGRA MARLERS. LEAST-BQUAGES PITTIEC OF A
CHAPMAS-LAYES PEAK

J. 6. Titheridge Proyaics Department, The University
at Acchising, Auctional collections can use plasma
frequency pe as a function of rost burght in mar a
layer past. This allows data iron lower helping in mars
components, to be comblood in a single less)—Aquares
components, to be comblood in a single less)—Aquares
adultion. The staled critical frequencies do not
define the linal value, but provides additional imput
to the lessi-aquares calculation. Seaults give
directly the L.H.S. Litting errors for the relition
frequency, the peak height and the scale height can
the scale height near the peat. With good data the
linal result is independent of this model. As the
smount and consistency of the data decreases, the
solution sutomatically gives more velight to the
initial landed is each be beight. This steally reduces amount and consistency of the dals decrosses, the solution sucteentially gives more weight for like initial handell scale beight. This steally reduces the normal tendency tor peak antrapolations to become erratic or shaurd as the quality of the data decreases. Gith vary poor data the model scale keight are still obtained from a least-quares colution, with some physical constraints. Thus optimus results are obtained with good dals, and acceptable peak profiles are obtained iron atl uselul imagrams. Honogram, real height, profile).

J.P. Matthews LSpace Eclence Ospartzeni ol CEA/ESIEC.

Noordelijh, The Matherlands)
Satolilta and ground based studies have demonstrated
that coberent VIV signals propagating in the terrestrial
nageotosphere can trigger diffuse and structured
emission buzata. A trigger diffuse CAS locospherte disturbances BHF/GES Scientillation OBSERVED AT ASCENSION DELAMA PROM 1980 THROUGH 1982 1980 THROUGH 1982

J.P. Mullen (Empanuel College, Bostoc MA 02115).

S. Markonzis, Santiany Basu and M. Whitney
Three years acintilistics usesurasants token at
Ascension claim have been reduced and are presented
here. The 1.3 DBs and 751 MHs signals of MARTSAT were
supplemented by J.9 GBs observations during january—
Hey 1981. While their response perterns are similar is
those dound earlier in the Airo-American zone, they
exhibited unusually (request orcurrence of heavy
exintilistics at GBs frequencies often exceeding 10 dB
et 1.5 GHs and T dB at 4 GHs. Those pettons are
attributed in pert to the position of the etation numer
the southern peaks of the Applerin unusually. Gouperleans
are ands between these and similar observations teles
et lions fong, suar the morrhare past of the anomaly.
(Equatorial scinrillation, UMP/GBs scincillation,
Appleton anomaly, asgueric indee). caissions which may operate when the cherrest signal propagass parallel to the generature like investing and this note. The theory is based on the concept that trapping of emergetic particles in the potential walls of the cohorent signal alters the gradient of the partitle distribution function with respect to persile velority. It, as a result of trapping, the gradient becomes sufficiently step, broad hand usive growth takes piece as predicted by established theory. The tesulting pitch angle diffusion of particles produces a care stable configuration in which the stem gradient is reduced towards that retresponding to the marginally stable distribution. Yor initially positive gradients in the energatic electron distribution function with respect to parallel velocity, wave growth takes plare above the frequency of the causative roberent signat. The theory predicts that the tee devices the take and the take the take the take the take the take the transmissione triggered in this way should rapidly increase with the and may reach maximum widths of several hundred He. Rad. Sel., Paper A\$1136

SA44 Idoospherio distutbancac BOTTOMSIDE SIMUSOIDAL MARGULARITIES IS THE EDUTATION IN SIMUSOIDAL MARGULARITIES IS THE EDUTATION AND SPECTAAL AFALTSIS E. S. CERS-SCREELATION AND SPECTAAL AFALTSIS E. L. CERS (Spens Sci. end Physics Prog., Univ. of Tesses at Belles, Sichardson, TE 750s2), G. B. Validsres, W. B. Mansoo, and J. P. McClura Squareful hottoside sinusordel TESS) irragues of experience been studied by applying techniques of experience been studied by applying techniques of experience and experience and experience and the state set. in order to determine the spatial displaceants between the denhity and transverse valueity romposcules of the irraguistic first and year loss recreases the denhity of the pitch and year loss valueity combinance as measured by the loss brill heavy. The analysis will indicate that the prich valorily combinance as indicate that the prich valorily romposance is indicated the the prich valorily romposance is indicated the the spectral post) to phis west with respect to the top departy justice of the section of the spectral post) to phis west.

theorem, the van difficomponent to almost in phone with the density timinations. Specifical the phone with the density timinations show a dorty policed at them its limitations show a dorty policed at them it will be seen that a dorty policed at them it will be sever-length and the series if the density of the wave-length one also perfect at I am to be selected at I be, but have seen posed at I am perfect at I am grave-lengths. Thus do the pitch water liveristic that the controllers as the weighteen, and has a responsibly dependent lengthma distributions. But a responsibly dependent lengthma distributions have controller as the weighteen, and has a responsibly dependent lengthma distributions have resulted and appear of the lengthma for the results of the adoption. The lengthma is the lengthma for the lengthma is the lengthma in the lengthma in the lengthma is and setting time in the length of training in the densities. Standard the length report and definite or endition on the Particles in legentarial lengthma is the definition. Standard line provide an important lengthma distribution of the setting of the densities. Standard line provides in lengthma distributions of the densities. 1. Geophyn. R. s., A. Paper SARIFE

SAINT-SAINTIN HAIMAR CHAIRIVATAINS OF CORR. SAINT-SAINTIN HAIMAR CHAIRIVATAINS OF CORR. THERMAD-1918, BY STEILARS C. Marandier and R. Benard I MC IVED 1918, A Avenue of Reprinte, 20120 Sale-Mara Francel, S. V. Venkateswatan broderent writter successrements of ion drift relocited to haider of the Australian. Nancoy tedar have been used to obtained by hatter-Saintin. Nancoy tedar have been used to obtained by hatter-Saintin. Nancoy tedar have been used to obtained by hatter-Saintin. Nancoy tedar have been used to obtained by the terest for the control of th

SESO WAVE PROPERTION OF ULF RADIO WAVES BY A PATCH OF 1095

B. Sorr, M.T. Rictonini, F. Stubbe and N. Fopulation.
Placek-Institut (Ur Astronomia, 1018 Stituburgindes, Place).

Manutements have been made at Bilboto in Morther Record of the effort of powerful By wyers, from the Morwoy of the effort of powerful By wyers, from the Morwoy of the effort of powerful By wyers, from the heating facility at Randjardsons, on the propagation wheating facility at Randjardsons, on the propagation will be determined by the propagation of heating facilities and the Case at transmitter (1721 Mail near VIF were from the Case at transmitter (1721 Mail near Note that the transmitter was feast to the vill applitude and phase perturbations was canned strots the outlines about and earlier to be been we canned strots the outlines about and says and the been was canned strots the outlines about not earlier and the propagation path end typical deviation was placed at the propagation of a disperse. The maximum eatues appared across the VIF heat the beam was symmetrically lorested across the VIF heat the says of the amporal varietility of the policy of the says of the amporal varietility of the policy angle (1943) showed that large enhancements of sufficient when the total fraction in the sample (1943) showed that large enhancements of sufficient where cororded during one control in the sample (1943) showed that large when the total fraction where sorted during one cut minimum is the root of the sample of t J. Gapphys. Res. A. Paper 442795.

U.S. Space Strategy

Following the formal announcement of a

Yews

national space strategy in August, President Ronald Reagan is moving ahead on many of his administration's declared objectives for arengthening the U.S. role in space-based research and space exploration. Possibly the most significant long-term as-

pect of the administration's national space strategy is its emphasis on international ampcration. While the U.S. space program in the 1960's and 1970's was locked by intense competition in the race to be the list to put a man on the moon, it may very well be characterized through the beginning of the next century by the spirit of international collabo-ration. The national space strategy calls for "increased international enoperation in civil space activities," particularly in the "develop-ment and milization" of the space station. In addition, in late October, President Reagan announced the passibility of a joint U.S.-Soviet simulated space rescue raission. In his statement, Reagan said that the U.S. "is prepared to work with the Soviets on cooperation in space in programs which are munal-ly beneficial and productive." Furthermore, National Aeronamics and

Space Administration (NASA) administrator James M. Beggs has suggested the possibility of a joint U.S.-Soviet lunar base. Many consider a manned lunar base the next Ingical goal after successful operation of the earth-orbiting space station. Speaking at a NASA symposium on "Lunar Bases and Space Activities in the 21st Century" at the end of October, Beggi unted that the establishment of a permanently manned lunar base would require the development of new technologies as well as management techniques and economic analyses to make it feasible and profitable. Because of the magnitude of such a project, Beggs said, international cooperation to share "risks and benefits" will be required. Such a project, he said, "neight even prove an irresistable lure to the Soviets," which would "certainly enhance the prospects for peace."

Beggs predicted that the United States would return to the moon within the next 25 years,

The administration's major goal for the civil space program, as outlined in die national space strategy, is to establish a "permanently manned presence in space." In this regard, design of the space station is moving ahead as scheduled. In September 1984, NASA issued a request for proposals (RFP) for definition and preliminary design of a permanently manned space station, which would be in low earth orbit by early in the 1990's. The RFP included four "work packages" of space sta-tion elements. NASA is planning to award competing contracts for each package that will be effective April 1, 1985.

Thirteen bids had been received by NASA light the submission deadline of November 15. 1984. Bueing, General Dynamics, and Martin Marietta all bid on the first work package, which consists of pressurized "common mod-ules" for use as laboratories, living areas, and lugistic transport. Lockheed, McDonr Douglas, and Rockwell International bid on the contract for the structural framework of the station. General Electric and RCA bid on work package three: preliminary design of automated free-flying platforms and provisions to service, maintain, and repair the platforms and other free-flying spacecraft. Garrett, Rocketdyne, and TRW all bid on prelimination design of planting spacecraft. inary design of electrical power generation. conditioning, and storage systems. The awarded contracts will last 18 months, and by 1987, NASA plans to begin final design and

development of the space station. Another major goal for the civil space program is to begin long-term planning for U.S. space activities into the next century. In October, President Reagan announced the creatinu of a national space commission, responsible for setting the agenda for the civil space program for the oext 20 years. This blue ribbon panel will be composed of 15 presidentially appointed members who will "ideotify long-range goals, apportunities, and policy opinious for civilian space activity." The consmission will be funded through NASA and will camplete its study late in 1985.

Hand in hand with the long-range consnis-sion report will be a study to review the goals and missions of civil agencies involved in earth science research "to insure a vigorous and balanced program of civil scientific research and exploration in space." The study. just getting underway, is to lie completed by April 1, 1985, and is being coordinated by the White House Office of Science and Technology Policy (OSTP). OSTP will seek input from policy-level personnel at agencies such as NASA, the National Science Foundation, the National Oceanic and Armospheric Administration, die Department of the Interior and the Department of Agriculture. Chief among the objectives will be insuring that research areas are not being overlooked and that research efforts are not being duplicated. The report will be reviewed by the Senior Interagency Group (SIG) for Space, a panel of Cabinet-level members, before being sent to

the President. Specifics on the scope and objectives of this study will be published in an perming issue of Eas. To insure a healthy U.S. space transportation system (STS), otherwise known as the space shuttle, after October 1, 1988, skuttle pricing will reflect the full cost of operations carried out for commercial and foreign users. To complement space shuttle operations, the administration also is promoting private sector space operations. Congress recently passed the "Commercial Space Launch Law." which defines regulations that private companies must meet to launch expendable launch vehicles (ELV's) or consmercial payloarls into space. The Department of Transportation, through its new Office of Commercial Space Transportation, will serve as a central agency

for processing commercial applications.

In addition, the administration is pushing for a change or climination of tax laws that discriminate against commercial space ventures and will target and support basic research and development activities that "may have implications for investors aiming to develop commercial space products and services." Along these lines, NASA recently released its formal policy on comorescial uses of

space that compains a series of initiatives designed to reduce the technical, financial, and institutional risks of commercial ventures into

### New Hydraulics Laboratory

The DeFrees Hydraulics Laboratory was opened in June 1984 as a 500-m² addition to the former hydraulics teaching laboratory in Cornell University's School of Civil and Environmental Engineering. Total laboratory space is now about 800 m<sup>2</sup> and is dedicated to basic and applied research and leaching in hydraulics, fluid mechanics, and hydrology. Three major equipment installations are in progress: a 33-m wave tank with a random wave generator for coastal/ocean engineering research, a 24-m wind-water tunnel for stratified flow and interfacial transfer research. and a 24-m tilring llume for upen channel turbulence aisc sediment transport research.

### Geophysicists

Wolfgang H. Berger, a professor of ocean-ography at Scripps Institution of Oceanograthy, has been awarded the 1994 A. G. Huntsman Award for Excellence in Marine Science from the Bedford Institute of Oceanography at Darrimonth, Nova Scotia, Carcada.

Rear Admiral Charles K. Townsend, director, National Ocean Service Office of Maxine Operations, leas been awarded the Commerce Department's Gold Medal, its highest award. Townsend received the award for recognition of his work oranging the Pacific Marine Center in Seattle, Wash., from 1986-1984.

Donald L. Turcotte, chaicman of the Department of Geological Sciences at Cornell University, was awarded a Regents Medal of Excellence from Cornell.

# **Books**

### **Eutrophication and Land** Use: Lake Dillon. Colorado

William M. Lewis, Jr., James F. Sannders, 111, David W. Grienipai ker, St., and Charles M. Brendecke, Eosl. Stud. Aual. Spath., vol. 46, Springer-Verlag, New York, x + 202 pp., 1984, \$39,80.

Reviewed by Timothy K. Kvatz

How and only a body of water responds to nutrient enrichment have been major questions faring aquatic evologists for the past several the ades. This book presents a 2-year case snaly of Lake Dillon, a mesotrophic rescrear in Colorado which is likely to receive higher untrient lapar in the lature. The nuthors claim three goals for the study: (1) to provide a comprehensive set of llumological data on the lake, (2) to dendt present mitrient sources of the lake and how they relate to land use, and (3) to construct a model capitble of predicting the troplake status of the lake given likely changes in land use. The authors are successful in accomplishing the lirst goal, do maderately in accomplishing the second, but leave the reader wondering about the

The book is organized logically and is easy to read. The lirst three chapters provide an introduction to Lake Dillon and detail the methods used in the study. Chapters 4 ough II report hasic lintuckigical information and are probably the strongest chapters in the linok. Because of the thoroughness of the data set, limnologists will find these climpters interesting and useful.

Chapters 12 through 15 deal with the mitrient contribution of the watershed. In these chapters, regression equations predicting ni-trogen and phosphorous yield from various land use practices and point sources are developed. Yields from these sources are summed to give notrient Input to the lake.

ATTENTION SUBSCRIBERSI

Beginning in 1985 Reviews of Geophysics and Space Physics will be titled Reviews of Geophysics. Approximately 600 pages to be published in Volume 23, 1985.

Deviations of the observed values from the predicted inputs based on these equations are assumed to be this to storage or removal of mutiems from river valleys. To deal with these discrepancies, the authors create an inventory function relating natrient storage or removal to magnitude of water timoff in such a way as to minimize the difference between observed and predicted matrient yield. One is harilly surprised when, after this correction, the various equations fit the observed data Chapters 16 and 17 describe the model and

the model's predictions. Rightly claiming that complex process models have limited use when prediction is a primary goal, the authors opt to design on empirical model. In an empirical model a variable of interest is predicted from one or more master variables. In this case the model first predicts mean annual untal phosphorus concentration in the lake. From the total P estimate, chlorophyll a, sec-rhi disk depth, and minimum O<sub>2</sub> concentration are predicted. Each of these parameters is an indicator of trophic status, so that with a given input of land use practices and water hurlger the model will make a prediction of the luke's trophic stams. After running the muxlel with 10 scenarios for land use practice and high or low water year, die authors conclude that the lake will become entrophic if high growth occurs without the adoption of numpoint source controls.

How good is die Lake Dillon model? The true test of an empirical model is how well It predicts. Predictive ability is difficult to assess from the information presented in the book Unlike the preceding chapters, where discussion of sources of error is detailed, there is no discussion in chapters 16 and 17 of confidence limits for the model's predictions. One clue that die authors themselves may not be overly confident of the model's predictive ability is found in the final summary chapter The chapter consists of 28 summary points which do an excellent job of presenting the major points of the book in condensed form. It may be significant that nowhere in the 23. points is any mention made of specific model predictions

This book will be interesting and useful to lake managers in particular and to limnolo-gists in general. Its major strength is the conpreliensive presentation of lliphological data. Luke modelers will likely find the modeling approach interesting but the model itself difficult to evaluate. At \$39.80, most libraries and some scientists will be able to add this volume to their collections.

Timothy K. Kraiz is the Site Manager of the Northern Lakes Long Term Ecological Research
Project of the Center for Limitalogy, University of
Wisconsin, Madison.



Call for Papers to be Published January 15, 1985

Abstract Submission: Abstracts should be submitted in standard AGU format. A sample abstract was published in Eos, August 14, 1984. The Call for Papers will contain detailed instructions and a somple abstract. Abatract Deadline will be March 13.

Scientific Sessions Special Sessions will be listed in the Call fur Papers. All scientific sessinus will be held no the Baltimore Convention Center.

Program Committee:

Meeting Chairmen and Union (U) Frank Eden, National Science Foundation Atmospheric Sciences (A) William Beasley, National Science . Foundation Geodesy (G) Demos Christodoulidis,

Goddard Space Flight Center Geomagnetism and Paleomagnetism (GP)
William MacDonald, State University of New York, Binghamton Hydrology (H) Leonard Konikow, U.S. Geological Survey, Reston

Ocean Sciences (O) Michael Bacon, Woods Hole Oceanographic Institution

Physetology (P) Raymond Arvidson, Washington University, St. Louis Srivmology (S) Charles Langston. Pennsylvania State University SPIC: Aeronomy (SA) G. G. Sivice. University of Alaska, Fairbanks SPR: Cosmic Rays and Solar and Inter-Planetory Physics (SC/SS) Leonard Burlaga, Goddard Space Flight Center (SC); Bruce Tsurmani, let Propulsion Laboratory SPR: Magnetospheric Physics (SM) George Parks, University of Washington, Seattle Volcanology, Geochemistry, and Petrology (V) Brnce Marsh, Johns Hopkins University, Baltimore

Social Events:

Icebreaker, May 27, 5:30-7:00 P.M. Awards Ceremony, May 29, 5:30 P.M.

Awards Reception, May 29, (immediately following the reception) President's Dinner, May 29, 8:00 P.M. (ticketed event)

Hotel Accommodations: Hotel reservations must be made through the Housing Bureau: deadline for reservations will be April 30. Detailed information on housing and meeting registration information will he poblished in late January. The meeting registration deadline will be May 9. The participating lintels and rates are: Dnys Inn 100 Hopkins Place (\$46 single, \$54 double/twin)

Haliday Inn Dinyntown 301 West Lumbard Street (\$49 single, \$59 double/twis)

Bultinore Plaza Pratt and Entaw Streets (\$58 single, \$68 dnoble/twin)

Omni International 101 West Fayette Street (\$68 single, \$88 double/(win)

Tremont Plaza 222 St. Paul Street (\$55 single, \$65 dinuble)

Howard House Hotel 8 North Howard Street (\$42 single, \$46 clouble, \$50 twin)

The Oceanography Report

The focal point for physical, chemical, geological, and biological oceanographers.

Editori David A. Brooks, Department of Ocean-ography, Texas A&M University, College Sta-tion, TX 77843 (telephone: 409-845-5527).

### A Multidisciplinary Oceanography Program on the Southeastern U.S. Continental Shelf

J. O. Blanton, J. A. Yoder, L. P. Atkinson, T. N. Lee, C. R. McClain, D. W. Menzel, G. A. Paffenhofev, L. J. Pietrafeva, L. R. Pomeroy, and H. L. Windum

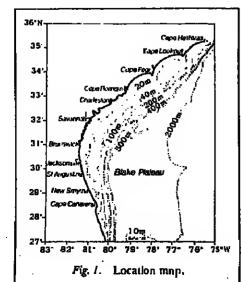
#### Introduction

Since 1976, the U.S. Department of Energy has sponsored a multidisciplinary research program to determine the physical processes which drive circulation and rontrol the chemistry and biology of the continental shelf waters off the southeastern United States (Figure I). This area extends from Cape Hatteras, N. C., to Cape Cagaveral, Fla. Joften called the Sooth Atlantic Bight (SAB)). Knowledge gained about water circulation across the shelf and at the western edge of the Gulf Stream has been used by comperating investigators (Table 1) and others to describe the circulation of shelf water, to determine where and how certain trace elements are transported and transformed, and to relate the circulation regime to biological production. The following description of the program is presented under three headings circulation, trace element geochemistry, and food chain dynamics.

#### Circulation

Two experiments were completed in 1980 and 1981, during which large arrays of current nieters, temperature recorders, and boitom pressure recorders were deployed. The arrays, designed to document the response of shelf waters to events induced by wind and by Gulf Stream disturbances (Figure 2). showed that low-frequency current and tem perature variability along the shelf break it primarily produced by eddylike disturbances along the Gulf Sream frontal zone. These disturbances travel northward at speeds of 0.S to 0.7 in/s at periods of 5 to 10 days [Lee and Brooks, 1979; Lee et al., 1981, 1984; Lee and Atkinson, 1983; Kourafalou et al., 1984). Along the middle shelf (depths of 20-40 m), currents at subtidal frequencies are strongly related to local wind forcing and pressure gradients [Lee and Brooks, 1979], similar to the response observed in the mid-Atlantic Bight Beardsley and Butman, 1974; Scatt and Csonady, 1976]. This portion of the shelf is vertically homogeneous in fall and winter. During spring and summer, the iniddle shelf is often vertically stratified, particularly in the northern and southern extremities of the SAB [Atkinson et al., 1983].

Circulation on the inner shelf (depths of 0-20 m) is influenced primarily by local wind forcing. Currents are also modified by densi-Freshwater inputs produce a band of low-sa-



linity water which establishes a frontal zone adjacent to the coast [Blanton and Athinson, 1978] where some dissolved and suspended material is effectively trapped. We only have two "snapshuts" (Figure 3) of the ocean currents on the inner shelf, where intensive measurements were made for a 2-3 day neriod (Blanton, 1981, 1984). The along-front flow is related to the direction of along-front stress. Cross-front flow diminishes with decreasing distance above the bottom and veers cyclonically. We think that periods of northward wind stress effectively remove dissolved material from the inner shelf [Blonton and Atkinson, 1983]. On the other hand, sinking material may be trapped on the inner shelf by onshore flow near the bottom. Moreover, the lower layer circulation appears to be strongly convergent during southward flow, which would also inhibit the offshore transport of any suspended material near the bottom. Thus the ability of the coastal front to inhibit the transfer of material across the shelf depends, to some degree, upon the frontal structure and its response to wind

### **Trace Element Geochemistry**

Shelf waters consist of Gulf Stream waters diluted to varying degrees by river rumoff. Trace element concentrations, although largely determined by concentrations of the occanic and freshwater end members, are also influenced by atmospheric inputs and by removal to, or release from, suspended and bottom sediments. We have examined some of the important pathways for mercury (Il'indom and Tnylor, 1979), arsenic [Wasleuchuk, 1978], copper [Windom et al., 1983], nickel, calmium, zinc, mangairese, iron JH. L. Windom and R. G. Sinith, Jr., unpublished manuscript, 1984) and lead (H. L. Windom, R. G. Smith, Jr., and M. Maeda, unpublished

Estuarine and inner shelf waters generally contain higher concentrations of trace metals than shelf waters near the Gulf Stream JH. L. Windom and R. G. Smith, Jr., unpublished manuscript, 1984). While inner shelf concentrations appear to result from the mixing of river and oceanic waters, atmospheric input is significant for some netals (Table 2).

The estuatine and inner shelf environment is a primary location for the deposition and resuspension of trace elements (Bothner et al., 1980 (see also Figure 4)]. The concentration of cadmium is maximum between salinities of 30-33 × 10<sup>-3</sup>, which soggests that cadmium is released from sediments on the inner shelf closest to the coast. On the other hand, iron concentrations suggest a first-order removal across the shelf JH. L. Windom and R. G. Smith, Jr., anpublished nranuscript, 1984]. Most of the removal probably occurs near the coast (i.e., salinities less than  $30 \times 10^{-8}$ ).

### Food Chain Dynamics

Since 1975, two types of upwelling events have been recognized as important to under-standing biological productivity of the middle and outer shelf. Both types occur throughout the year at the shelf break in response to eddies and meanders of the Gulf Stream front which occur at characteristic periods of S-10 days. These Gulf Stream disturbances affect the outer shelf (depths greater than 40 m) and cause nutrient-rich water to be present on the outer shelf approximately 80% of the time resulting in intense phytoplankton blooms (Athinson et al., 1978; Lee et al., 1981; l'oder et al., 1983]. This is the first type of upwelling. The second type begins as the first does but occurs when the Gulf Stream is vertically stratified, about May-October. Upwelled water then penetrates across the shelf as a subsurface intrusion of cold nutrient-rich water. The distance of penetration depends opon the wind stress, the local topography, and the density of resident shelf waters [Atkinsan, 1977; Blanton et al., 1981; Janow Pietrafesa, 19B2]. Intrusions are most dramatic south of Jacksonville, fla., 130°N) and in the Carolina Cape region north of 35°N. Intrusions can penetrate all the way to the coast off northern Florida and north of Cape Fear but only to the midtle shelf off Georgia and South Carolina. A given intruded water mass may result from several apwelling events at the shelf break and thus may have a residence time on the shelf of several weeks. Production in the intruded water mass reaches 3 g C m<sup>-2</sup> d<sup>-1</sup> near the peak of the phyto-plankton bloom (J. A. Yoder et al., unpublished manuscript, 1984). The annual outer shelf estimate of primary production is 380 g

Chlorophyll a concentrations in intruded water masses usually reach maxima about 1 week after intrusions occur (Figure S). The doubling time of Intrusion chlorophyll a is about 1-2 days, if exponential increases are assumed. This matches a half-life of 1-2 days for nitrale.

While production on the outer shelf is primarily controlled by upwelled nutrients, pro-duction on the lauer shelf off Georgia and South Carolina is affected by recycling and by

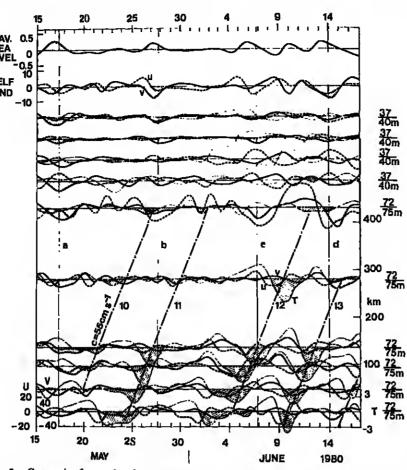
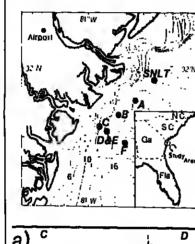
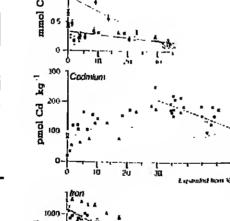
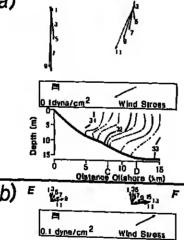


Fig. 2. Composite figure showing response of middle and outer shell currents near bottom to Gulf Stream and wind events [from Lee and Athinson, 1983]. Propagating events [10– 13), shown by slanted lines, have a phase speed of 5S cm s<sup>-1</sup> and connect cold anomalies at the shelf break Iwavy hatching). Nonpropagating events (a-d), shown by vertical lines, connect southward wind and current events and coastal sea level set-up (dotted sharling). Numbers at far right of figure denote depth of observation over total water depth.







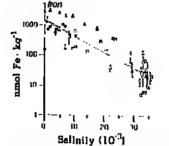


Fig. 4. Changes in concentration of three trace elemetits versus sallnity across the inner shelf off Georgia (from 11. L. Windom and R. G. Smith, Jr., unpublished manuscript, 1984). (top) Dissolved organic carbon appears to be the only trace element that is conservative; [mitdie) Cadmium [like copper and nickel) is released from inner shelf sediments; (botiom) Iron (like manganese und zinc) is removed and deposited primarily in nearshore sediments. Dillerent symbols denote different experiments at different times.

Fig. 3. Current hodographs at two lo-cations in the Inner shelf frontal zone during southward [a] and northward [b] wind tress. Note the more inclined frontal zone during southward stress and that flow near the surface is offshore during bods conditions. Currents have been averaged for four consecutive tidal cycles.

20 [

Distance Oilehore (km)

nutrients supplied from the many marshes and rivers [l'oder, 1984]. Annual inner shelf primary production averages 285 g C m<sup>-2</sup> but exceeds 600 g C m<sup>-2</sup> near the mouth of a major southeastern estuary [Haines and Dun-sten; 1975; Thanas, 1968]. Four characteristics regulate primary productivity on the inner shelf. First, with the exception of the Florida. coast south of 30°N and possibly the Carolina Capes area, phytoplankton production is not affected by upwelled nutrients. Instead, "new" nutrients enter the inner shelf from the many estuaries, salt marshes, and rivers that line the Georgia/South Carolina coast, A

large proportion of the exported nitrogen is not available to phytoplaukton until mineralized by lieterotrophs because most is in dissolved organic and/or particulate organic form [Bishop et al., 1984]. Second, light is alemuated quickly with depth due to the high turbidity of inner shelf waters [Oertel and Dunstan, 1981]. Third, the existence of the coastal frontal zone (discussed above) inhibits the cross-shelf exchange of dissolved and suspended materials [Blanion, 1981; Yoder et ol., 1981], thereby affecting the residence time of nutrients and phytoplankton on the inner shelf. Fourth, large titlal amplitudes (2-3 m) induce some sediment stirring in shallow water near the coast, which may release nutrients from the sediments [Yoder; 1984]. The nportance of sediment-derived natrients is being studied...

The shallowness of the inner shelf, the abundance of suspended matter, and tidal allrring enhance the abundance of bacteria. [Pomeroy et al., 1983], Sediment/water Interaclions regenerate phosphate and ohimonia and resuspend organic detritus. These pro-

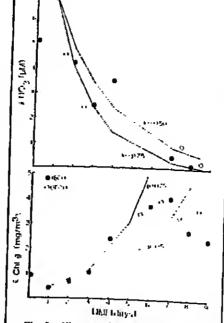


Fig. 5. Temporal change in mean intrusion nitrate and chlenophyll a. Lines illustrate (wo different rates (base 2) of exponential decrease for nitrate and two different rates of exponential increase for chlorophyll a [From Yoder et al., 1983].

The Weekly Newspaper of Geoglatuca For specifiest treatment of contributions, send directopies of the double-spaced frames up to one of the editors named below and one copy to

Editor-In-Cleicf: A. F. Spillans, Jr.: Editore Marcel Ackermon, Mary P. Anderson, David A. Brooks, Beine Doe, C. Srewart billion (Unforth Chile L. Goad, Coms J. Lanzerom, Rober A. Flamory: Managing Editor: Barbara F Richman; News Writer: David W Rolds: Copy Edior/Writers Ruth Soulsted. Editorial Assistant: Carel M. Ezzell; Production Smill; Celac Kair Burkhalter, Uar Sung Kun, Usa Lielutenstein, Kathren M. Partan

Officers of the Union Charley L. Drake, Prevalent, Peter S. Engleson, President-Elect; Peter M. Bell, General Series tary: Juan C. Roederet, Foreign Sectrativ: James A. Van Allen, Past President; A. F. Spil-hare, Jr., Executive Director, Waldo J. Smith, scrative Director Emergus.

For advertising enformation, contact Robout Lattle, advertising enordinates, at 202-462-6997 or tall free of 800-424-2488. Advertising units be informa-live and consistent with the scientific and educadonal goals of A1311 and a subject to approval by AGD. Advertisery and their agents assume ability for all consens of their advertisements anny in an ionicite of new anvertisencing and for any clabits arising therefrom against the publisher. Differs he advertisements are subject to all laws and are void where problibited.

appright 1984 by the American Geophysical lon. Material to this issue only be planted upled by individual scientists for regence from class team use. Permission is also granted be use on quotes, lignics, and tables for publication brsdentify tambs and populate For permission for any other uses, contact the A17D Publica-

views expressed by this publication do not meesonly reflect official positions of the American Geophysical Duion unless expressly stated.

idocalpilon prior to membra is inclinical in an and does (\$20 per year). Information on ustituinnal sales cijalous is available on request. Second-class passage point at Washington, D. C., and at additional enabling offices. For, Transp-tons, Journal Originary University (1988) (1986) 39(1) is published weekly by

American Geophysical Pulon 2000 Horida Avenne, N.W. Washington, 110, 20000

Cover. Surface pigment concentrations off the southeastern coast of the United es are highest at the coast freil areas). Somewhat lower concentrations (yellow areas) extend offshore, particularly in the area cast of Savannada, Georgia, where the Gulf Stream turns eastword (dark blue area bordering light blue arens). Note the solated path of higher concentration (yellow) just upstream from the eastward deection. This patch is the result of high primary production generated by upwell-ing in the cold core of a Gulf Stream fronal eddy or lilament (see McClain et al., 1984). This image originated from the Coastal Zone Color Scanner almard the Simbus 7 Satellite, April 17, 1979. Color code for pigment cutteentrations the milligrams per cubic nicier): blue, <1.25; light blue, 0.25-0.45; light green, 1.46-0.7; dark green, 0.7-1; yellnw, 1-2; red, 2-4; brown brown, >4. For further information, see .: article A Multidisciplinary Oreanography Program on the Suntheastern U.S. Cantle nental Shelf, by Jackton O. Blanton, this issue, The Oceahography Report, p. 1282.

(Photograph touriesy of C. R. McClain, National Aeronauties and Space Administration, Conductor, Space Administration, Conductor, Space Administration, Conductor, Space Contest. Italion, Goddard Space Flight Center, Greenbelt, Md.)

TABLE 1. Principal Investigation Supported by the Department of Energy in the Southeastern U.S. Commental Shell Program Affiliation L. Atkinson hydrography, nutrient dynamics inner shelf circulation, shallow water frontal zones J. Manton SKIO T. Lee RSMAS Gulf Stream dynamics, shelf circulation C. R. McClain NASA D. W. Menzel SKIO SKIO G. A. Paffenhofer

remote sensing zooplankton, nutrient dynamics NCSU UGA shelf dynamics, tidal currents microbiology, nutrient dynamics SKIO trace element dynamics SKIO phytoplankton, untrient dynamic

NASA: National Aeronautics and Space Administration/Goddard Space Flight Center; NCSU: North Carolina State University, Raleigh; RSMAS: Rosenstiel School of Marine and Atmospheric MCA: University of Miami, Fla.; SKIO: Skidaway Institute of Oceanography, Savannali, Ga.;

TABLE 2. Comparison of Atmospheric and Riverine Trace Metal Inputs

	to Shelf Waters			
	Atmospheric Input,* nmol kg <sup>-1</sup> yr <sup>-1</sup>	River Input,* nmol kg-1 yr-1	Ratio R (Atmospheric Input to River Input)	Resulting Zero Salinity End Member,†
Iron Manganese Cadmium Copper Nickel Zinc	6.3 0.22 0.012 0.98 1.4 1.9	23 14 0.0026 0.37 0.19 0.40	0.27 0.01 4.6 2.6 7.4	700 330 0.39 32 38
*Assuming that shelf area is S.O. v. 104 L. 2			57	

\*Assuming that shelf area is  $5.9 \times 10^4$  km², that shelf water volume is 1600 km² (Athinson et al., 1983), and that total freshwater runoff is 66 km².

†Concentration =  $|R + 1\rangle$  C<sub>n</sub>, where R is the ratio of the atmospheric input to the river input and C, is the observed weighted mean river water concentration.

cesses provide additional substrates (compared to those available to nrid- and outer shelf environments) for both free and attached batteria and other microbes. Bacteria are more abundant and their mean size larger on the inner shelf than in the waters of the onter shelf. On the nuter shelf the abundance of free liacteria is about 105/ml, reaching 106 above intrusions. On the other hand, normal abundance of free bacteria along the inner shelf is 10%ml [Pomeroy et al., 1983].

High zooplankton densities are found with-

L. J. Pictralesa L. R. Ponteroy

H. L. Windom

J. A. Yoder

in upwelled waters, particularly during suntmer, when intruded waters remain on the shell for weeks. Dominant taxa include the appendicularian, Othoplema, which reaches concentrations as high as ~ 103 specimens per in within both intruded waters and the overlying surface mixed layer. Capepoils of the genera Paraculanus, Euralanus, and Temore and the cyclopoid Owner sp. attain densities of  $\sim 10^{2}$  to  $10^{3}$  specimens per m<sup>-3</sup>. Three concentrations are similar to or surpass thuse of the same taxon in major upwelling areas of the world [Paffenbofer, 1983]. Growth and productivity of larval and adult fish may also he affected by upwelling events. Recent studies have shown that schools of adult fish were concentrated within intruded waters on the outer shelf [Athinson and Targett, 1983]. In general, the outer shelf has more larval fish than the middle or inner shelf. Thus most larval lish are located in the shelf zine where the production dynamics of their probable load (plankton) is principally controlled by mrwelling [Puler, 1983].

There is lurreasing evidence that seasonal

changes in the physical regime may eject ma-terials to the onter shelf, where they may be

entrained into the Gulf Stream. Climatolog

1983] suggests that kiw-solinity water is car-

ral distributions of salinity [Athinson et al.,

#### **Future Plans**

ried northward and olfshore in spring and senthward along the coast in autumn. This is consistent with dimatological wind regimes [Weber and Blanton, 1980] and, in the spring situathun, with evidence from satellite imagery [see cover, this issue). Whether the tonguelike ilistributinus shown in the imagery are propagated or remain stationary is a question which requires further study. Other satellite images sluw a large pool of high chlorophyl a situated near the shelf break at 32°N. An experiment in spring 1985 will test the hypothesis that material transported offshore from the inner shelf is entrained and reneut" cyclonie eddy at 32°N. This eddy results from the sudden turning of the Gulf Stream eastward at 32°N and its return to the shelf break at 33.5°N (Pietrafesa, et al., 1978; Bane and Brooks, 1979). While evidence suggests that low-salinity water appears near the shelf break at 32°N in spring, we do not knuw the trajectory, nor do we understand the biological and chemical processes that occur along the way. Our first experiment, SPREX (spring removal experiment), will take place during a time that will derive maximum benefit from a U.S. Mineral Management Service study of the Gulf Stream. During that time, current meters will be deployed over a 3-4 month period, and two ships will be used over a 20-day period to conduct Lagrangian flow experiments, obtain continuous norizontal profiles of temperature, salinity, itted chlorophyll a, map hydrographic proper ties of shelf waters, and conduct biological sampling for phytoplankton, zooplanktoh, and bacteria. In addition, several special arrays will be deployed in areas off the Georgia coast as shallow as 4 m to measure currents and subsurface pressure. Investigators from the Bruokhaven National Laboratory will also participate in these studies.

Low-salinity water is carried along the coast and southward thiring autumn (Atkinson et al., 1983). It is usually found hugging the coast of Florida during October. Presumably, this water is carried and required by energetic water is entrained and removed by energetic eddies influenced by bottom topography near Cape Canaveral [Blanton et al., 1981; Lee and Athinson, 1983]. An experiment is planned in the Cape Canaveral area within the next 2-3

### Acknowledgments

We wish to express our appreciation to the U.S. Department of Energy, which has supported this work through contracts number DE-AS09-80EV10331-A004 and DE-AS09-76EV00889-A009. We are also grateful for support from Minerals Management Service of the U.S. Department of Interior and from Science Applications, Inc. Anna Hovene and Suzanne Alciniosh drafted the illustrations. and Susan Salver typed the manuscript.

Atkinson, L. P., Modes of Gulf Stream intrusion into South Atlantic Sight Shelf waters, Geophys. Res. Lett., 4, 583-586, 1977. Atkinson, L. P., and T. E. Targett, Upwelling along the 60-nr isobath from Cape Canaveral to Cape Hatteras and its relationship to fish distribution, Deep Sea Res., 30, 221-226, 1983.

Atkinson, L. P., G. A. Paffenhofer, and W. M. Donstan, The chemical and biological effect of a Gulf Stream intrusion off St. Augustine, Florida, Bull. Mar. Sci., 28, 667–679, 1978,

Atkinson, L. P., T. N. Lee, J. O. Blanton, and W. S. Chandler, Climatology of the south-eastern United States continental shelf waters, J. Geophys. Res., 88, 470S-4718, 1983. Bane, J. M., and D. A. Brooks, Gulf Stream meanders along the rontinental margin from Florida Straits 10 Cape Hatteras, Geophys. Res. Lett., 6, 280-282, 1979.

Beardsley, R. C., and B. Butman, Circulation on die New England rontinental shelf: Response to strong winter storms, Geophys. Res. Lett., 1, 181-184, 1974.

Bishop, S. S., K. A. Emmanuele, and J. A. Voder, Nutrient limitations of phytoplankton growth in Georgia nearshore waters, Estuanes, in press, 1984.

Blanton, J. O., Ocean currents along a near-shore frontal zone on the continental shelf of the southeastern U.S., J. Phys. Oceanogr., 11, 1627-1637, 1981. Blanton, J. O., Coastal frontal zones as barri-

ers to offshore fluxes of contami Rapp. P. 1'. Reun, Cons. Int. Explor. Aler, in Blanton, J. O., and L. P. Atkinson, Physical

transfer processes between Georgia tidal inlets and nearshore waters, in Estuarine Interactions, edited by M. Wiley, pp. 615-532, Academic, New York, 1978. Blanton, J. O., and L. P. Atkinson, Transport

and fate of river discharge on the continental shelf of the southeastern United States, . *Geophys. Res., 88*, 4730-4738, 1983, oton, J. O., L. P. Atkinson, L. J. Pietra-

fesa, and T. N. Lee, The intrusion of Gulf Stream water across the continental shelf due to topographically induced upwelling, Deep Sea Res., 28A, 393-105, 1981.

Bothner, N. H., P. J. Aruscarage, W. M. Fer-rebec, and P. A. Baedecker, Trace metal concentrations in sediment cores from the continental shelf off the southeastern United States, Estuarine Coast. Mar. Sci., 10, 523-541, 1980.

Haines, E. B., and W. M. Dunstan, The distribution and relation of particulate organic material and printerly productivity in the Georgia Bight 1973-74, Estuarine Coast Mar. Sci., 3, 431-441, 1975.

Janowitz, G. S., and L. J. Pietrafesa, The effects of alongshore variation in bottom topography on a boundary current [topographically induced upwelling). Gont. Shelf Res., 1, 123-141, 1982.

Kourafalou, V., J. D. Wang, and T. N. Lee, Circulation on the continental shelf of the southeast United States, 3, Modeling the winter wind-driven flow, J. Phys. Oceanogr., 1022~1031, 1984.

Lee, T. N., and L. P. Atkinson, Low-frequency current and temperature variability from Gulf Stream frontal eddies and atmospheric forcing along the southeast U.S. outer continental shelf, J. Geophys. Res., 88,

4541-4567, 1983. Lee, T. N., and D. A. Brooks, Initial observations of current, temperature and coastal sea level response to atmospheric and Gulf Stream forcing on the Georgia shelf,

Gream forcing on the Georgia snear, Geophys. Res. Lett., 6, 321–324, 1979. Lee, T. N., L. P. Atkinson, and R. Legeckis, Observations of a Gulf Stream frontal eddy on the Georgia continental shelf, April 1977, Deep Sea Res., 28, 347–378, 1981. Lee, T. N., W. J. Ho, V. Kourafalou, and J.

D. Wang, Circulation on the continental shelf of the southeast United States, I, Subidal response to wind and Gulf Stream forcing during winter, J. Phys. Oceanogr., 1001-1012, 1984.

McClain, C. R., L. J. Retrafesa, and J. A. Yoder, Observations of Gulf Stream-inthiced and wind-driven upwelling in the Georgia flight using ocean color and infrared imagery. J. Geophys. Res., 89, 3708-

Oertel, G. F., and W. M. Dinistan, Susprinded sediment distribution and certain aspects of phytoplankton production off Beorgia, USA, Mar. Geol., 40, 171–197, 1981. Paffenhofer, G.-A., Vertical zeuglankton distribution on the northeastern Florida shell

and its relation to temperature and food aboutlance, J. Planton Res., 5, 15–33, 1983. Pietrafesa, L. J., J. O. Blanton, and L. P. Atkinson, Evidence for dellection of the Gull Stream by the Charleston Rise, Gulf Mireum Mug., 4, 3-7, 1978.

Poneroy, L. R., L. P. Atkinson, J. O. Illanton, W. II. Campbell, T. R. Jackson, K. Fl. Kerrick, and A. M. Woods, Microbial distribution and abundance in response to physical and biological processes on the confinental shelf of southeastern U.S.A., Cont. Shelf Rev., 2, 1–20, 1981.

Scott, J. T. and G. T. Csanady, Nearshore currents off Long Island, J. Grophys. Res., 81, 5401-5409, 1976.

Thomas, J. P., Influence of the Aliamalia River on primary production beyond the mouth of the river. M. S. thesis, 65 pp., Univ. of Ga., Athens, 1966a Waslenchuk, D. G., The budget and geo-

chemistry of arsenic in a continental shelf environment, Mar. Chem., 7, 39-52, 1978. Weber, A. H., and J. O. Blanton, Monthly mean wind fields for the South Atlantic Biglit, J. Phys. Oceanogr., 10, 1256-1263, 1980.

Windom, H. L., and F. E. Taylor, The flux of Sen Res., 26A, 283-292, 1979.

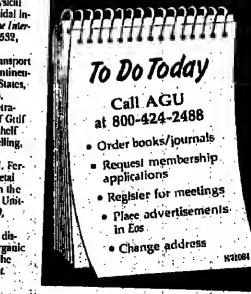
Windom, H. L., G. Wallace, R. Smith, N. Dodek, M. Maeda, R. Dulmage, and F. Storti, Behavior of copper in southeastern United States estuaries, Mar. Chem., 12, 183-193,

Voder, J. A., Statistical analysis of the distribution of fish eggs and larvae on the south-eastern U.S. commental shelf with comnients on oceanographic processes that may affect larval survival, Estuarine Coast. Shelf

Sci., 17, 637-650, 1983.
Yoder, J. A., L. P. Atkinson, T. N. Lee, H. H. Kim, and C. R. McClain, Role of Gulf Stream frontal eddies in forming phytoplankton patches on the outer southeastern shelf, Limnol. Oceanogr., 26, 1103-1110,

Yoder, J. A., L. P. Atkinson, S. Bishop, E. Hoffman, and T. Lee, Effect of upwelling on phytoplankton productivity of the outer southeastern United States continental shelf, Cont. Shelf Res., 1, 385-404, 1983.

The authors ore with the Shidaway Insti Oceanography . Savannah . Ga .



#### RATES PER LINE

Positions Available, Sarvices, Sapplies, Courses, and Announcements: first interview \$5.00, adultional Insertione \$4.25.

Positions Wanted: first insertion \$2.00, additional Insertions \$1.50 Student Opportunities: first insertium Iree, additional insertions \$2.00.

For more information, call 202-482-8903 or toll free 800-424-2488.

#### POSITIONS AVAILABLE

POSITIONS AVAILABLE

Sedimentologial-Oreanographer/Texaa A&M University. Applications are invited for a tenure trark faculty position in the general field of marine sedimentology. The poeition will involve graduate level tearhing and air pervision of graduate student research. The surcesaful applicant will have demonstrated excellence in or a strong potential for independent research in the field of marine sedimentation. The position is available beginning September 1, 1985. Salary and rank will be commenturate with experience and qualifications. Applicants are invited to submit currirula vita, ropies of publications, names of three persona who may serve as references, and a letter outlining the applicant's teaching and research interests by December 31, 1984, to Robert O. Reid, Distinguished Professor and Head, Department of Oceanography, Texas A&M University, College Station, Texas 77843.

Texas A&M University is an affirmative action/equal opportunity employer.

equal opportnolty em plóyer.

Computer Manager/Minicomputer Specialist.
Memphia State University seeks a cambidate to manage a PDP 11/44 and a major facility expansion to include a superntinformputer system (VAX 11/785 class) to be itesticated to research applications in the Geological Sciences and Genphysics. Hardware and software are designed for digital seismic data acquisition, digital seismic ratta processing, and graphical representation of geological and geophysical data.

cal data.

The caudidate innest have at least a BS degree in Computer Science, Electrical Engineering or related field; three years programming experience including FORTRAN and ASSEMBLY; knowledge of various computer hardware and two or more widely used uperating systems; ability to perform numerical data analysis. Knowledge of PASCAL and Clanguages and RSXIIM operation system will help. Salary is negotiable depending on experience. Applicants shrushd submit a resume, repiet of academic

ranstripts, and the names, addresses and telephone numbers of three references to: Dr. Jer-Ming Chiu Demphis State University Tennessre Earliquiake Information Center Memphis, TN 38152. Applications must be received by December 10,

Memphis State University is an equal opportunity affirmative action employer.

Garnagia Institution of Washington/Postdoctoral Fellows 1885–88, Department of Tarrestrial Magnatian. Endowed postdoctoral fellowships in private institution, emphesizing maximitm freedom of research in areas of seismology, geophysics, isotope and trace element geochemistry, cosmorhemistry, accelerator posts institutional programments and statement of the programment of t and trace element geochemistry, cosmorhemistry, arceleraint mass spectrometry, planefology, end star and planef formation. Renewable for second year. Completed applications due February 1, 1985. For information write February 1, 1985. For information write Februaring Committee (1), 0e-partment of Terrestrial Magnetism, Carnegie Institution of Waehington, 5241 Broad Branth Road, N.W., Washington, D.C. 20015.

Vinnaen and minority candidates encouraged.
Carnegie Institution of Washington is en EOS/AAE.

Geodesy/Estimation of Washington is en EUS/AAE.

Geodesy/Estimation BTS, an innovative firm lorated adjacent to NASA/GSFC in suburban Maryland, has o position available for a senior analysis at the Als/PhD level with experience in geodesy and parameter estimation/error analysis techniques. Additionol experienre in aotellite dynamics is benefitial. RTS is a research ond development rompany providing scientific support for government and private industry, and is proud of it's people orientation. Professional activities ond educational advancement are actively encouraged and supported. We offer an excellent salary structure and progressive benefits. Please send your resume in confidence to: BUSINESS AND TECHNOLOGICAL SYSTEMS, INC.

INC. 10210 Greenbelt Road, Suite 440 Seabrook, Maryland 20706 Attention: Vonghan Limbrick U.S. CITIZENSHIP REQUIRED EEO M/F/H/V

Isotopo Geochemistry/Mass Spectromatry,
McMinster University invites opplications for a tenure track position at the Assistent or Junior Associate Professor level. The candidate should have
completed the PhD degree and preferably have
postgrarinate research experience. A strong background in the theory and practical use of mass
spectrometers is essential. Familiarity with software,
including interfacing, would be a definite asset. At
McMaster, there are a number of mass
spectrometers for the onalysis of both stable and radiogenic istopes. Recent acquisitions include an ICP

quadripole/mass sperirometer and a five-collecturiolid source mass spectrometer. The surresshif candidate will be expected to pursue an independent research program, as well as interact strongly with an active group of geochemists at McMaster.

The closing date for applications is February 1, 1985.

In accordance with Canadisn immigration requirements, priority will be given to Canadisn citizens and permanent residents of Canada.

Send resume, transcripts and the names of three referees to:

Dr. R.H. McNuu, Chairman Department of Geology McMaster University Hamilton, Ontario, LBS 4M1.

Scientist. Seek Ph.D. in geochemistry or related field to join a Nuclear Regulatory Commissionsponsored research program to develop a data base on the source term for low level nuclear wastes. Candidates should be prepared to study and quantify radionuclide interactions in mineral/water systems related to waste form learling and learhate migration specific to the disposal of low level nuclear wastes. Apply to: Dr. R. Dayal, Department of Nucleor Energy, Building 830, Brookhaven Natlunsi Laboratory, Associated Universities, Inc., Upton, Long Island, NY 11973.

Equal Opportunity Employer m/f. Equal Opportunity Employer m/f.

Geophyelebt. Ph.D or M.S. in geophysics. The position requires a broad background in thenretical seismology, applied mathematics, and physics. Expenience in scientific programming using FORTRAN is desired. Familiarity with statistics, time series analysis and numerical methods and the UNIX operating system is desirable. Preference will be given to applicate with publications. system in deal of the state of

314 Montgomery Street Alexandris, VA 22314 icl.: 703-836-3882 Teledyne Geotech is an equal opportunity em-

Assistant/Associate Professor of Geophysics. Applications ore invited for a tenure track position as assistant or associate professor of geophysics in the College of Oreanography at Oregon State University to complement the present eight-member geophysics faculty. Caustidates must have a PhD or equivalent and a demonstrated ability to conduct independent research in theoretical or observational geophysics sustained by external research funding. Most solid earth geophysics research specialties will be considered. Duties will include teaching graduate rourses, supervising graduate students and developing a grant-funded research program. Those inter-

### Research **Scientist**

MIT's Research Laboratory of Electronics sneks research Scientist to work in electromagnetic wave theory field and its applications to geophysics Research emphasizes ellects of ionesphere, troposphere and earth terrain, EM wave plasma interaction in the enosphere. Will collaborate with lacully, supervise sludent research, and have demonstrated capability for altracting support. Requires Ph.D. II E.E. or Physics and over 3 years' relevant experience.

Send 2 copies of resume, ATIN: Jeb No. R84-582, Io: Ms. Sally Hensen, MIT Personnel Office, E19-239, 77 Messachusetts Ave., Combridge,

ested should submit a resume, mannes of three refer-ences and a brief statement of research plans by February 28, 1985 to:

Aving Itran
College of Creatography
Chrigin State University
Corvollis, OR 97334.
Gregon State University is an albrinative action/
equal opportunity employer and complies with Section 503 of the Rehabilitation Act of 1973.

University of Illinola at Chieago. The Department of Geological Sciences seeks in fill tennie track positions probably, but not necessarily, et the rank of assistant professor, probably effective Fall, 1985, pending budgetary approval, in one or both of the following disciplines: If Geophysics (preferably in seismulogy); 2) serimentary geochemistry. Each person is experted to teach both undrugraduate and grotuate courses and to conduct a vigorous research program, including the supervision of graduate students. PhII experient. Applicants should within a detailed resume, names and addresses of these references, and an explanatory statement of research and teaching interests by February 28, 1985, to Robert DeMar, Department of the Geological Briences, University of Illinois at Chicago, Chicago, Illinois 60880. Representation of the Hepartment will be at the AGO Fall Meeting in Desember.

The University is an equal opportunity/allironative action employer.

Geoselenees. Applications are invited for two fac-only positions with responsibilities, respectively, in 11 petrology and mineralogy and 21 historical and physical geology. Appointments will be full time as-sistant professor or invition level, non-neume-track, bir 2 or 3 years beginning sequender 1985. Send letter, resumer, transcripts, and three recom-mendations by February 1, 1985 to John B. Brady, Chair, Hepartment of Geology, Smith College, Nurthampton, MA Ulunt, Smith College is an equal upportunity employer.

Physical Oceanographer/University of South Carolina. "The Marine Science Program and Hepartment of Geology anticipate a termine track faculty position in physical oceanography to begin to the academic year 1985–86. Safary and rank are dependent upon qualifications; however, preference will be given to applicants at the Assistant Professor level. The Program seeks an applicant with specialty in either theoretical, manuerical or lack to ceanography. Active oceanographic and transport processes; thermoduline and next successions and transport processes; thermoduline and deep studies of estuarine and roastal rivulation, mixing, and transport processes; thermodaline and deep orean mixing; palero orean original publication; and physical-biological coupling in nearshore ecorystems. Applicants unto there a Ph.H. degree, substantial qualitionis in mather research, and a strong commitment to traching and research. Submit resume, a brief statement of research interests and name/addresses/phony mambers of three references in: Dr. Björn Kjerlve, Chairman, Search Committee, Marline Science Program, Hoivershy of South Carollina, Columbia, SC 20208 before 31 January 1988.

The University of South Cacolina is un equal op-

Theoretical Space Plosma Physiciat. The Space Sciences Laboratory of the University of California Sciences admirancy of the University of California of Berkeley subrits applications for a renewable three-year appointment as a Senior Fellow with Principal Investigator status. We me seeking a PLD, physicist who has demonstrated leadership and creativity in space plasma theory and who will develop his/her nwn research group and participate in educational netivities of the academic departments. The level, in he determined at the time of appointment, will be Assiston, Associate, or Full Research Scientist depending upon qualifications.

Via, bibliography, statement of prospective research program and three letters of reference should be sent by February 1, 1985 to P. Buford Price, Director, Space Sciences Laboratory, University of California, Berkeley, CA 94720.

The University Is an equal opportunity/affirma-

he University is an equal opportunity/affirm

Memorial University of Newfoundland Centre for Earth Resources Research, Department of Earth Science/Project Geophysicists. Applications from qualified individuals are invited for two (2) Project Geophysicist positions as a part of a CIDA funded programme in Botswans. The job location is in the Department of Geological Survey, Lobatse, Sostwans. Expertise in the use of geophysics in mineral exploration and/or groundwater exploration is required. The project runs for five years with initial contracts for a two-year term. The usual overseas allowances and benefits apply. For more information contact:

Dr. J.A. Wright
Department of Earth Sciences
Memorial University of Newfoundlanti
St. John's, Newfoundland
ALB 3X7
700-737-7580.

University of South Carolina. Two year postdoctoral research assistant position anticipated. For an should have a strong background in structural goodogy of complexity deliorined regions along with an interest in geologic mapping and integration of diverse kinds of geologic and geophysical data Starting date as early as January 15, 1986. Closing date for applications December 31, 1984; Applications with vine, interests again possible referees about be sent to Prof. Robert D. Haicher, It. Department of Geology, University of South Carolina, Columbia, SC 29208.

The University of South Carolina is all affirmative, action/equal proportunity amployer.

Structual Geologist/Petrologist. The Department of Geology at George Mason University istate innversity in Northern Virginia: Paulit undents) seeks to fill a tenne track position at the assistant professor position to Gegin in Lall 1985. The successful applicant will teach moder graduate igneous metanton-più petrology and structural geology. Preference will be given to applicants with additional experiment contonin geology, georgiasses, or contonin geology, are mitosto, or contonin geology, accombisses, or contonin geology, accombisses, or contoning acoustic contoning geology, georgiasses, or contoning acoustic contoning geology, georgiasses, or contoning geology, georgiasses, or contoning geology, georgiasses, pro-

numbers of the Committee on Theoretical Astro-physics.

We havire impairies and applications from quali-fied theorists for a position to be folled this year. Applicants should send their con indian vitae and philography, together with the names of hour pro-fessional references and any other supporting mate-rials to Professor J. R. Jokipii, Chairman of the The-oretical Astrophysics Steering Cammitee, Depart-ment of Planetary Sciences, University of Arizona, Tusson, AZ 85721 USA, before March 1, 1985. Lat-er applications will be considered.

The University of Minnesoto: Structual Geology/ Tectonics. The University of Geology and Fara-physics invites applications in a new tennic track position in structual geology and tectonics. Candi-dates will be expected to carry out an active re-search program in their held of interest and to as-sume teaching and advising responsibilities at the undergraduate and graduate levels. A 19/0, is re-quired. The position will be available Laft 1985. Ap-plication deadline is February 15, 1985. Applicants should send rurriculum virae, list of publications, statement of research uncrease, and names of at least three referees to Peter Guilleston, Charman, Department of Geology and Geophysics, University Department of Gardogy and Geophysics. Instrum. Department of Gardogy and Geophysics. Inversity of Minnesona, Minnesona 55155. The University of Minnesona is an equal opportionly educator and employer and specifically nivites and encourages applications from women and minorities.

congrammer summer with orean dynamic is expected cased in the modeling of the suscile occum processes is preferred. The cambidate should be compresent in

the anilysis of pertinent observations, and be able to teach a variety of graduate rourses in physical regimentarity. The applicant should liste an extend Phill, with so residently background in physical retrieval. He is not established between the physical retrieval phill, with some sensing of the orean. The surcessful and experimental interest in strickle remote sensing of the orean. The surcessful ambitude will be expected to each one or two quarters per years, conduct repressored research, and provide threis supervison. The acress to computer, that archive, and research vessel facilities is excellent. Basic of applied research opportunities are alminiant. Interactions with oceen dynamicius in the Meteorology Department are also possible. Salarier are autrative and are determined by the qualifications of the successful randiclate. By I January 1985, send a curriculum vince, hue more oand addresses of three references, and a statement of research and instructional intensis to:

Professor Christopher N.K. Mooers, Chairman Department of Oceanography Naval Postgraduate Srhool Minnerey, CA 93945.

Applicants who are rurrently doctoral candidate will be considered for appointment as instructors, with a tenure track appointment upon completion of the degree. For additional information, fele-time Professor Edward B, Thornion at 408-846-2847.

The Naval Postgraduate School is an equal proportion of the degree.

The Naval Postgraduate School is an equal oppor-mity/affirmative action employer.

Anticipated Selamology/Paleomagnetism/Tectonophysics: Louisisma Basic University. The Department of Geology is searching for candidates to fill as many as frur positions in geophysics and two in rectumphysirs. The principal interest is in persons specializing in theoretical ond applied seismology. Expertise in wave propagation, tomogrephy, and/or digital pracessing is especially snught. Outstanding candidates in paleomagnetism are also sought, with emphasir on tectunic applications. In tectomophysics, specialization in rock mechanics or numerical modeling is of interest.

At the present the Department has three geophysicists and by Spring, 1985, will have two structural geologins. The geophysics program has eVAX 11750 computer, a PreSets seismic data processing system, several seismic field acquisition systems, and numerous terminals and peripherels for the VAX end the University's 18M 3081 and 3083 systems. Plans for acquiring additional computer equipment are underway.

rystems. Plans for acquiring additional computer equipment are underway.

Successful applicants are expected to offer graduate and unifergraduoic courses in their specialies and to develop a strong record of funded research and probletation. The positions ere at the Assistant Professor level, but appointment at higher rank will be considered for candidates with appropriate experiment.

Applicants should submit a vita, representative re-prints, and a ratement of teaching and research in-terests and areange for three letters of recommen-dation to be sent to: Chairman, SPT Search Com-mittee, Department of Geology, LSU, Baton Rouge, LA 70803-4101. LSU IS AN EQUAL OPPORTUNITY/AFFIR-MATIVE ACTION EMPLOYER.

Isotope Geochemist or Economic Geologia/University of Washington. The Department of Geological Sciences usuaes applications for a tenure track appointment at the Assistant Professor level with specialization in Isotope Geochemistry or Eronomic Carology. The position will be available in the fall of 1985. Candidates must hold a Ph.D. degree and be committed to establishing a nationally prominent research program. Applicants in isotope georhemistry should have experience in the measurement of isotopic alumniances in radiogenic systems.

THE AEROSPACE CORPORATION SPACE **SCIENCES LABORATORY** 

The Space Sciences Laboratory of The Aerospace Corporation invites opplications for a lull-time position in the Atmospheric Sciences Department to carry out research in upper atmospheric and ionospheric physics and the effects of the near-earth space anvironment on space aysteins. Ongoing activities include investigations of the earth's mesosphere, thermosphare and lonosphere and their interoctions with the magnetosphere. These investigations make use of both ground and space-based instrumentation and involve the collection, analysis and theoretical interpretotion of dote of basic scientific interest.

The applicant will be expected to participate in individual and colinborative research projects involving both experimental theoretical components. A PhD and, praferobly, 2-5 years of experience in one or more of the following areos is desired: space plasma physics theory ond/or simulation, auroral and singlow processes, radiation transport, atomic and inolecular spectroscopy, lonospheric physics, upper otmospheric dynomics and chemistry, optical and re-optical instruments ion, modeling and analysis of sparecroft/rocket doto, esperially as related to remote sensing and offied theoretical disciplines.

Salary will be commensurate with experience. Applicants should send o letter of interest and o resume including the nomes of three references to:



# The Aerospace Corporation

Dr. Joe M. Straus Space Sciences Laboratory M2/255 Dept. 00624 P.O. Box 92957 Los Angeles, CA 90009

> An Affirmative Action Employer U.S. Citizenship Regutred

and in the application of isatopic claim in solving problems in perudogy, crust and mentle evolution or rormochemistry. Applicants in eronomic geology should have a strong barkground in goodhemistry with particular research interests in the application of chemical principles to the processes of ore genetis. Candidates will be expected to tearli at both the undergraduate and graduate levels and in expervise or adulate research.

graduate research.

Send letter of application, fluctuating description of research interests), curriculum vitae, and marnes of four referees to Chairman, Search Committee, Department of Geological Sciences, AJ-20, University of Washington, Seattle, Washington 98195.

The University of Washington is an Affirmative Action/Equal Opportunity Employer.

Action/Equal Opportunity Employer.

Memorial University of Newfoundland Oppartment of Earth Seleurce, Ceotre for Earth Resources Research NSERC/Petro-Canade Research Chelr in Marine Crustal Selsmolugy. Applications are invited for this new Research Clear in seismology at Associate or Full Professor rank. Funding for the Cheir abu provider for a senior research associate and e multichannel marine seirmic system. Opportunities for culleborative research esist within the Centre, with industry and with the Atlantic Geoscience Centre paniculerly with projects on East Coast crustal structure. The Department has 35 feculty, 10 research fellows, 60 graduate equients, well-equipped laboratories and a strong geophysics research group. In accordance with Canadian Immigration requirements, priority will be given to Canadian citizens and permanent residents of Canada. Send enquires or application with names of three refereer to: 0r. C.R. Barnes, Head, CEAR, Oepartment of Earth Sciences, Memoriel University, St. John's, Newfoundland A18 3X5, Canada. (Telephone 709-737-8142.)

phone 709-737-8142.)

Faculty Positions/The Pennsylvaola State University. The Department of Geosciences invites applications for three (3) senure track faculty positione in any of several fields of specialization. The faculty reak associated with each position is presently open, although salary funds currently evailable ere sufficient for, of most, one senior full professorship. The successful candidates must be, or have demonstreted the potential to become, nationally recognized leaders in their fields. They must also have en interest in teaching and advising graduate ond undergraduate students. Instructional end reaearch ereas in which particular neede have been identified include, but are not necessarily limited to: equeous geochemistry, with emphasis on the kinetics of low-temperature rock-water interactions; experimental petrology, with emphasis on the equilibrium and kinetic properties of petrological systems; heavy isotope geochemistry, with emphasis on element distribution systemetics and their geological applications; hydrogeology, with emphasis on the physics of fluid flow and mass transport through porous media; minerel physics/mineralogy, with emphasis on petrological applications of crystallochemical methods; rock physics, with emphasis on the dynamical properties of upper-crutal rocks; sedimentary geochembly, with emphasis on diagenesis of fine-grained

rock physics, with emphasis on the dynamical properties of upper-cruital rocks; sedimentary geochembiry, with emphasis on disgenesis of fine-grained sediments and organic matter; and structurel geology, with emphasis on regional tectonics.

The selection of persons to fill these three positions will be based in part on the extent to which their future research efforts will romplement und funher strengthen our programs in Geochemistry and Mineralogy, Geology, and Geophysics. Qualified persons should, therefore, include a brief description of their future research objectives with their resumes and the names of three references to:

C. Wayne Burnham, Head

Department of Geosciences

The Penasylvania State University
5038 Delke Suiding

University Park, Pennsylvania 18802.

The deadline for applications is April 30, 1985.

An Equal Opportunity/Affirmative Action Employer.

Beismologiai/University of Utab: The Department of Ocology and Geophysics of the University of Utab seeks applicants for a tenure track faculty position in seismology at the assistant to associate professor level. Applicants with backgrounds and apeciaties in seismic imaging, seismic reflection or theoretical seismology will be given preference. The individual will be expected to teach undergraduate and graduate courses and to pursue an active research program with graduate ausdenss. A seismic imaging laboratory with a VAX 1173B, PPS array processor, plottors, and processing and synthetic seismogram software is available to the successful candidate. Current research in seismology includes: cardiquage research sufficiency apply 11-70 computer, industrying of the Intermountain seismic belt by an 85 station telemetered network utilizing an onred nelwork utilizing an online PDP 11–34 romputer; mejor experiments in seismic refriction and reflection prediting for crueal structure; and allied research in tectromphysirs. The opportunity exists to participate with several other faculty in an integrated program of tectonics, seismoby and sedimentology directed toward crustal studies and petudento exploration. The geophysics component of the department has acrive research and teaching programs in electrical and electromagnetic methods, thermal properties of the earth, patential fields, and seismology. The department has close associations with the numerical analysis and dara processing groups in computer science, electrical engineering and mathematics. The closing date for applications is December 15, 1985. A Ph.D. is required for this position. Applicants should submit a vita, transcripts, a letter describing his/her research and teaching goals and names of two persons for reference. Qualified persons should send their applications to William P. Nash, Clatimum, Department of Geology and Geophysics, University of Utah is an equal appointunity/affirmative action employer.

affirmative action employer.

affirmative action employer.

Chalrpercon/Tha University of Tulsa, Department of Geoacicaces. Numinations and applications are invited for the position of Chairperson. Camilidates should have a Ph.D. and a distinguished record of teaching and research. Leadership and administrative skills and experience to interact effectively with ecademics, industry and alumni are required.

The department of geosciences has ten faculty members and is located in a new teaching, and research complex. There is a strong emphasis on coft rock geology and exploration geophysics in the department which has grown steadily in the last decade. Equipment includes a VAX 11-750 computer with en array processor and seismic data processing software, SEM, Microprobe, XRF, XRD, gas chrometographs and a mass spectrometer. Library reosurces which are supported by "Petroleum Abstracia" are excellent.

Nominations and applications should be sent to: Colin Barker, Department of Geosciences, University of Tulsa, 600 South College, Tulsa, Oklehoma 74104 by January 15, 1985.

The University of Weshlower (Construction of the last construction of the processor of the colon of the plantary of Weshlower (Construction of the last construction of the plantary of Weshlower (Construction of the last construction of the plantary of Weshlower (Construction of the last construction of the last cons

University of Washington/Geophysice. Applications invited for a research faculty opening at the Assistent Profestor level. Candidatee are expected to establish innovative, high quality research programs in rock and mineral physics and to obtain funding (including salary) to maintain programs which should complement and/or augment exicting programs in rock and mineral physics at the UW of Drs. J.M. Brown and Y. Sato-Sorensen.

Send resume and four letters of reference prior to January 18, 1985 to: Professur R.T. Mertill, Geophysics Program AK-50, University of Washington, Seattle, WA 98195.

The University of Washington is an affirmative action/equal npportunity employer.

Sciamologist/University of Piserio Rico. The University of Piserio Rico and the Center for Energy and Environmental Research seek applications for a position in the field of seismology. The position is for part-time funtruction at the University of Puerio Rico, Cayey and investigation of data from a 20-station short period, digital seismic network in Puero Rico and the Virgin Islands. The applicant is expected to have demonstrated ability to work with data from a seismic network or ability to work on seismic lassarit problems.

All interested persons should submit to letter of application, a detailed restance of educational experience and a simunary of interests to:

Dr. William R. McCann
Lamont-Doherty Geological Observatory
Palisades, New York 1996-1

Telephone: 914-350-2900 ext. 377

University of California/Graduate Assistantships.
University of California, Sauta Borbara Graduate
Fellowships, Teaching Assistantships and Research
Assistantships in geology, geophysics, marine geophysics, Special Regents Fellowships with four year
of full support available to putstanding applicants.
The department stresses a close interplay between
geology and geophysics as well as field research opportunities both on hind and at sea, Majors in physics, engineering and mathematics as well as geological sciences welcome. Apply to:

Professor Ken C. Macdonald
Craduale Advisor
Department of Geological Sciences
University of California
Sainta Barbara, CA 93106.



# Office of Naval Research GRADUATE FELLOWSHIP PROGRAM





For study and research leading to doctoral degrees in specified engineering/science disciplines.

**Introduction:** ONR will award up to 45 three-year fellowships for study and research at U.S. institutions offering doctoral degrees in designated

Eligibility: Participants must be U.S. citizens or nationals and receive a baccalaureate degree in

**Objective:** To increase the supply of U.S. nationals trained in disciplines critical to the U.S.

ellows selected in 1985 will rece \$13,000 for the first year of tenure. ONR will pay the institution full tuition and fees and provide \$2,000 to the Fellow's department.

**Duration:** Up to three years if academic progress is is satisfactory.

ONR Graduate Fellowships awarded in this fourth year of the program will be for study and research in nine major disciplines:

> Electrical Engineering Computer Science Naval Architecture and Ocean Engineering Materials Science

Applied Physics ce Mechanical Engineering Life Sciences

Mathematics Secretary of the Navy Fellowships in Oceanography

For application forms and information contact. ONR Graduate Fellowship American Society for Engineering Education 11 Dupont Circle, Suite 200 Washington, D.C. 20036

Only U.S. citizens and nationals are eligible. Application deadline: January 31, 1985 Offers of appointment around March 31, 1985 ONR ASEE are equal opportunity employers,

See Announcement for Detailed Information

will be given to applicants with additional expensive in contouring goology, grophysics, or computer applications, who hold a 1911 to have one mean completion, and who appear communed to an academic career involving twicking, research and service. The geology program is new, with new capinment in a new science building, from hill-time Lamba, several part-time family, 60 geology majors, and 10-20 geology BX, graduates was breat. The CSUS-Reston and the Smithsonian-Wardington are a short distance from the minerally, Applicants should send a graduate of their teaching and research abilities, a resume, and the manes of their relevances by February 15 to Donglas Moor, Department of Grobing, George Mason University, Fairlax, VA 22000, AA/EOE.

Theoretical Astrophysica/University of Arisono.
The University of Arizona is building an interdisciplinary program in riaron citeal astrophysics. Participaling departments include Astrophysics, and Planetary Sciences. We interpret theoretical astrophysics broadly, and areas of interest range from theoretical glanetary physics to resunding, including attach and molecular physics, star formation, conclused matter physics, gravitational dynamics, exceeds.

Cetera. We have just filled the first position under this initiative. We autoipate several more openings for trained line faculty positions in theoretical Agro-physics over the next few years. Appointments will be in one or more of the participating departments and can be rither serior or justice faculty beed, the pending on qualifractions. Appointers will also be members of the Committee on Theoretical Astendonics of the Committee on Theoretical Astendonics.

Faculty Position in IGnandeal Greenaugraphy.
An arademic position transe trackl is presently available at the assistant or prinor associate professor level in the Department of Germography, Naval Posigradiane School. An orean dynamicial experienced in the model-four of tracare the second more processor.

SOLAR PHYSICIST - BRANCH CHIEF

SPACE SCIENCE LABORATORY NASA-MARSHALL SPACE FLIGHT CENTER

Huntsvilla, Alabama 35812

The Soles-Terrestrial Division expects to appoint a tolar physicist to the posttion of chief of the Saler Science Brench. The Branch's fifteen members (six Ph.D.s), visitors (NRC post-does, summer feculty, etc.), contractors, and estoclates are involved in an earlier research program in solar physics. A broad range of research topics is being pursued at present, with emphasis on the formation and structure of the contraction of distorted magnetic fields. the transition region, the occurrence and consequences of distorted magnetic fields and their accompanying electric currents, and numerical modelling of coronal evolution and interplanetary dynamics. Branch activities include the operation of a vactor sciety magnetic fields. oler magnistograph, the energyle of dela from the UltraViolet Spectrometer and Polerimeter (UVSP) Instrument abourd the Solar Maximum Mission Seletita, and the atilizing of MSFC engineers with the scientific espects of soler missions (e.g., Sunish, Advanced Soler Observatory and Pinhole/Occultar Facility). In addition, x-ray falescope development work is underway. Computing facilities are assistably being upgraded and soon will be unsurpassed anywhere. Collaborations with extramural colleagues are encouraged, and there is the opportunity to Isain and advise graduate

The appointed must be a secognized sesearch scientist with flerests. In addition to performing his as her own research, the appointed will be expected to guide the work of the Branch and to pursue new directions as appro-Triele. It will be the sasponsibility of the Brench shief to recruit new Branch mem pers, post-docs, and visitore as opportunities esise. The Branch chief will overses the submittel of proposels for funding and will be expected to work dosely with the Office of Solar and Hellospharle Physics at NASA Headquarters, Salary will be GM14 or 15 (42,928 - 65,642) depending on experience and quelifications.

Forward resumes and seferences to the following address no later than Jenuary 15, 1985.

U.S. Citizenship Required

Dr. C. R. Chappell **ES51** NASA/Marshall Space Flight Center Huntsville, AL 35812

Equal Opportunity Employer

NASA

1204

Faculty Position. The Oepastment of Earth and Space Sciences, SUNV Stony Brook invites applications for a tenore track faculty appointment. Rank and salary will be dependent on qualifications. Access of specialization are open but preference will be given to applicants whose research interests complement those of the sedimentary geology program in the areas of: 1) quantitative modelling of heat and mass teamsice on a regional or global scale; or 21 low-temperature geochemismy, sedimentary petrology, economic geology, hydrogeology. The successful randidate must have a Ph. D., a demonstrated research potential aird an interest in tearhing gradurandode must have a rh. II., a demonstrated research potential airel an interest in tearhing graduale and undergraduate students. Qualified persons should send a resume and arrange for three references to be sent to: Dr. C.N. Hanson, Unaisman, Department of Earth and Space Sciences, SUNY Stony Brook, Stony Brook, NY (1794-2100, SUNY Stony Brook is an afternative action/equal popularity and send amplicate. At #300, 84

opportunity educatos and employer. AK#300-84.

opportunity educates and employer. AK#3011-84.

Northern Arizona University/Depastment Chaisperson. Chairperson, associate or full professor. Department of Geology. Northern Arizona University, beginning sumater 1985. Specially open but preference will be given to applicants with a otrong background in tectonics and tectonic problems. Applicants must be capable of interacting professionally with an active and diverse faculty of 14 geologists and geophysician. Candidates alrould expect to continue an active research prugram, should have administrative capabilities and a dedication to quality teaching. The Department has been granted planning authority for a Ph.O. program so it is essential the outcestful candidate possess the desire to guide the Department through the final planning stages NAU has a traditional emphasis on field problems in the Colurato Plateau and adjacent areas; we are expanding our analytical fastilite to improve theosetical and expestinental capabilities. Salary will be compellite and negotiable. Additional duites include teaching and supervising graduate nudent research. Application deadlae: January 15, 1985. Send curriculum vitae, statement in research interests and manes of four professional seferences to Scarch Committee—Cude C, Repairment of Genlogy, Box 6030, Northern Arizona University, Flaguar, AZ 86011.

Northern Arizona University is an equal apportunity/affirmative action employer.

Northern Arizona University is an equal hyportunity/affirmative action employer.

Northern Arizona University is an equal hyportunity/affirmative action employer.

Graduate Fellowahlpa/University of Oklahoma.

The School of Geology and Geophysics offices fellowhips for Ph.D. attuly in each of the following broad disciplines: (1) origin, ascent, and fractionation trends in magnim and associated ore deposits; (2) formation and tectoric evolution of confactual lithosphere, including geophysical propenies and structures of the upper crust; and (3) sedimentary processes, including organic and inorganic diagencies, evolution of hydrocarbons, and correlation using biosteatigraphic methods. Average fellowship ailpends are for \$10,0000 month and are renewable annually on a competitive basis. Fellowship awards include a waiver of out-of-state tuition and fees.

The School of Geology and Geophysics persently somists of 19 full-time faculty. Research facilities in the school include a stable isotope laboratory; ocquing geochemitry laboratory; computer automated X-ray diffication and finorescence equipment; atomic absorption and neotron activation analysis equipment; scanning electron microscope with energy dispessive analyzer; transmission electron microscope; fission-track dating laboratory; fluid inclusion microthermometry laboratory; 2 kh hydrothermal laboratory for phase equilibrium experiments; high-pressure rock mechanica laboratory; paleomagnetic laboratory to phase equilibrium experiments; high-pressure rock mechanica laboratory; paleomagnetic laboratory of op phase equilibrium experiments; high-pressure rock mechanica laboratory; paleomagnetic laboratory for phase equilibrium experiments; high-pressure rock mechanica laboratory; paleomagnetic laboratory and magnetication apparatus; 24-, 48-, and 192-channel digital seismic recording systems; a VAN 11-785 conpouter with high-tesolution graphics and image-display terminals, with seismic and image processing software; and a 84,000 vol-

ume geology and geophysic library located in the

department.

For further information on faculty and active research project, contact: Revin Crowley, School of Geology and Geophysics, University of Oklahoma, 830 Van Vleet Oval, Norman, OK 73019.

Seismologisi/University of Illinois. Applirations are solicited for a tenure-track position at the Assistant Professor level in seismology. A recalive Individual is sought who will develop a research program that complements our exirting programs in seismology (rurrently emphasizing source properties), geodynamics, tectonics, and rock/mineral physics. An excellent research environment and outstanding facilities are available both in the Oeparimsm and the University. A Center for Super Computer Research and Development is presently being formed at the University. In addition, our campus ir the site of a proposed regional computational farility. Opportunity exists to interact with the department of Theoretical and Applied Mechanits. The portion is expected, to be tilled as early as Fall, 1985. Salary is commensurate with experience; a PhD is required. The successful candidate is expected to participate in teaching and advising at the graduate and undergraduate levels. For equal consideration, interested individuals should send curriculum vitae, firt of publications, statements of research interests and names of three or more references by Oecember 15, 1984 to:

1984 to:
Professor Albert T. Hsui
Oepartment of Geology
University of Illinois at Ucbana-Champalgn
1301 W. Grsen Street
Ucbana, Illinois 61801.
Td: 217/333-7732 oc 333-3542.
The University of Illinois is an equal opportuni

mative action entployer.

affirmative action employer.

Chief, Land Scioneea Branchi U.S. Department of Commerce, National Oceaale and Atmosphesic Administration (NOAA), GS-1801—14, Salary Range \$42.928 to \$55,807, Sultland, MD. The Climate and Earth Sciences Laboratory, National Environmental Satellite, Oata, and Information Service (NESDIS), NOAA, amounces a accancy for the position of Chief, Land Science Oranth. The Climate and Earth Sciences Laboratory is repaonsible for applying satellite observations to problems in the atmospherir, oceanic and land sciences. The Land Sriences Otanch uses linagery and radiomatric observations from meteorology and radiomatric observations from meteorology and radiomatric observations from meteorology and radiomatric observations from meteorology, and radiomatric observations from total participate in the recently initiated International Satellite Land Surface Climatology Project. Branch scientists: I] develop algorithms for detiving land sorface variables from satellite radianter observations, 21 test, validate and apply these algorithms, and 3) perform research on and sociace proceases using the satellite based measurements. Examples of land variables of interest include anow and ice, skin temperature, surface radiation budget, soil moist tie, vegetation cover, and hydrological parameters.

The successful applicant will direct the activides of the Branch and manage its rerources, including research grants/contract with external institutions, the will also actively engage in personal research in one of the land science areas. The successful applicant minist have a record of scientific schievement on the application of remote sensing to the above stated problemy, as evidenced for publications in the sci-

that fills have a record of scientific achievement on the application of remote sensing to the above stat-ed problems, as evidenced by publications in the aci-entific literature. The justion requires a Ph.O. In the physical sciences or equivalent and at least five years of relevant experience. Familiarity with pro-gramming of mainframe computers and experience with interactive image processing systems are also desirable.

lestrante.
Persons Interested in applying must request a consins

**NATIONAL SCIENCE** 

**FOUNDATION (NSF)** 

Program Director

Instrumentation and Facilities Program

NSF's Division of Earth Sciances is seeking quelifiad epplicants for

Facilities Progrem. The position is in the excepted service end will

be tilled on either a parmenent, rotator or temporary basis. The per

annum salary for the permanant or tamporery position will be et

GH-15 lavel, \$50,495 to \$85,642. Normally, the rotetor cendidate

receives a laava of absance from his/har employar and selery is

salary renge for the rotator position is \$40,000 to \$66,400. Tha

program provides support for the purchase and upgrading of re-

search instrumentation and equipment for earth sciances research

at universitias end collages in tha U.S. Some support is also pro-

vided for the design and development of new research instrumen-

Applicants about have a Ph.D. in the Earth Sciences or equivalent

tation for earth sciences, end tor the operation of centrelized re-

axperienca. In addition, six to aight years of successful scientific

rapperch axperience in geochamistry and/or geophysics beyond

the Ph.D. Damonstration of extensive research exparience end

productivity could be considered as equivalent to a Ph.D. A broad

mentation as well as familiarity with the U.S. scientific community

are elso required. Administrative experience, preferably in a uni-

varsily or in government, is highly desirable. Applicants should

general knowledge of earth sciences research and research instru-

National Science Foundation,

Personnel Administration Branch.

1800 G St. NW.

Rm. 212, Washington, DC 20550

Attn: Catherine Handle

When applying for the permanant position indicate #EX 85-2 in the

NSF is an Equal Opportunity Employer.

cover latter and #EX 85-1 whan applying for the rotational post-

tion. For further information cell 202/357-7840. Hearing impelred

eearch facilities used by several institutions.

send resumae indicating current selery to:

Individuals should cell 202/357-7492.

set in eccordance with NSF's Circular 167, Rotator Progrem. The

tha position of Program Director for its new instrumentation and

### UNIVERSITY OF IOWA DEPARTMENT OF PHYSICS AND ASTRONOMY

The Depertment of Physics and Astronomy enticipetes openings for two tenure-track assistant protessors in August 1985. Preterence for one of these positions will be given to an experimentalist, in an exceptional case e term or tenured appointment at the associate professor or professor levet will be considered, in addition, one or more openings for visiting teculiv members et any level ere enticipated. Current reseerch interests in the depertment ere radio and optical astronomy and the following spectalities in physics: stomic, condensed metter, elementary particle, isser, nuclear, pleams, and space physics. Faculty duties include undergraduate and graduete teaching, guidance of research students, end personal research. interested persons should submit a résumé end a statement of research interests and strange for three tetters of recommendation to be sent to Search Committee, Department of Physics and Astronomy. The Untversity of lowe, lows City, IA 52242.

The University of lows is an equal opportunity/affirmative action employer.

qualification requirements, by writing to NOAA, F84, Room 2051, Washington, O.C. 20233, ATTN: RAS/OC24, Barbara Jones, or calling 501-763-1986. Applications should be prepared on Stamlard Form 171

Ocpariment of Commerce is an Equal Opportunity Employer, U.S. Citizenthip cequited.

Paculty Positions/Asizona State University, Oepartment of Geology. Applications are invited for two tenore trark positions, beginning in August of 1985 at the rank of Assistant or Associate Professor. The selected candidates will be expected to display exrellence in teaching and to develop vigorous programs of research on important geological problems. Research areas which complement our axisting strengths, especially igneous, metamorphic, or sedimentary petrology, ace the most desirable. Preference will be given to applicants with a demonstrably strong quantitative approach to problems of wide interest. Please send a detailed statement of research and teaching interests and a resume with names of four references and a resume with names of four references by January 15, 1985, to Paul Knauth, Chairman, Department of Geology, Arizona State University, Tempe, AZ 85287.

Arizona State University is an equal opportunity/affirmative action employer. affirmative action employer.

Andona sale University is an equal opportunity affirmative action employer.

Assistant Professorahlp in Obeservatioani Coastal Dyoamica/University of North Carolloa Institute of Marine Scieacea, Morehead City. Tenure track position for a physical scientist with interests in neashore (continental shelf and/or estuarine) cirtainion will be availabel on july 1, 1985. This will be a research position, carrying a nine-month state supported salaty commenturate with experience. The appointee will be expected to develop and cacry out a field program in nearshore circulation. This person will be staffed at a research laboratory swhere programs related to coastal dynamics are underway. These programs include suddes of sediment dynamics, and sediment/water chemical exchanges, plankton patchiness and larval dynamics. The appintee will also interact with faculty and mulents in an academic Curriculum in Marne Sciences at Chappel Hill. Faculty in this unit conduct research on carbonate platform geology, Gulf Stream dynamics and sediment/water chemical exchanges.

Interested applicants should send a letter describing their research interests, a curriculum viae and tames of forur reference to Oirk Frankenber, Director institute of Marine Sciences, 5407 Arendell Street, Morehead City, NC 28557 by January 4, 1985.

The University of North Carolina is an affirma-

The University of North Carolina is an affirmathe action/equal opportunity employer.

the action/equal opportunity employer.

Department of Geoselences/University of Houston.

The Oepartment of Geoselences has permission to the American of Geoselences has permission to the American of the It members of our faculty (3 in geophysics. This is a tenure track position with a starting date of Angust 1988. We are particularly interested in talking with individuals with a strong background his theoretical seismology, experimental seismology, applied seismology. Salaty and rank will be a function of experience. Applicants should submit: [1] a curriction was: [2] a brief statement of research interests; [3] a brief statement of teaching interests; [4] three letters of recommendation; [5] copy of graduate transcripts.

cripta.

John C. Builer, Geoscleiwes

University of Housion, University Park

Housion, Texas 77HIM

Stuart A. Hall will be at the AGU meetings in Uecember and would like to talk with interested appli-

The University of Houston is an equal opportuni-

Marine Geophysicial/Texas A&M University.

The Oepartment of Oceanography Invites applicants for a tenure track position in its geological/geophysical section in the general field of marine geophysics and global tectonics. A Ph.D. is required. Rank and salary of the polition are open. The successful applicant will be expected to initiate a vigorour research program, have on Interest in seagoing activities, and interact with colleagues in the Departments of Oceanography, Geophysics, and the Genments of Oceanography, Geophysics, and the Gen-dynamics Research Program. Dutles will also include the teaching of M.S. and Ph.D. students. The posi-tion is available beginning September 1, 1985. Ap-plicants abould submit a detailed resume including names of references and statement of research in-terests to T. K. Treadwell, Faculty Search Commit-tee Chalrman, Department of Oceanocation Transree Chairman, Department of Occanography, Texas
A&M University, College Station, Texas 17643,
Closing date for applications is January 31, 1985,
Texas A&M University is an equal opportunity/affirmative action employer.

firmalive action employer

Faculty Position in Structural Geology/Tectonics.

The Oepartment of Marine, Earth and Atmospheric Sciences. Nocth Carolina State University, has a tenure track opening at the Assistant or Associate Professor level in the area of structural geology/tectonics. The position will be filled for the beginning of the Fall 1985 term. The department currently has 31 full-time faculty, including 12 geologiats and geophysiciats.

The auccessful applicant will be expected to have completed the PhD degree. Courses to be taught include undergraduate structural geology as well as courses in attuctural aralysis, tectonics, or other areas of research activity. He or she additionally will be expected to develop a vigotous program of sponsored research and to direct graduate student research projects at the MS and PhO level.

Please send complete resume and the names of all less tithree pelcrences to V.V. Cavaroc, Scarch Committee Chairman, Department of MEAS, North Carolina State University, Raleigh, NC 27695—8208, phone (918) 737-2212, Applications will be considered as received, with a closing date of january 15, 1985.

North Carolina State University is an exital one

ed as received, with a case of the section of the s

Phyoleol Oceanographer/North Carolina Stote University. Applications are invited for a unemounth, state funded, tenure track position as the assistant or associate professor level in descriptive physical oceanography. The successful applicant will have a Plank, a background incorran riculation and state of the art instrumentation, and will be expected to develop a strong field program and teach grafulae level rourses. He art she will also have the opportunity of interacting with thirty-two disparamental facing in various areas in oceanography, mateorology and geology. Send curriculom vine and the namer of three inferences by January 31, 1985 to: Or. G.S. Januwitz, Chairman, Search Comminee in Physical Oceanography. Department of Marine, Eacth and Annospheric Sciences, 80x 8208, Raleigh, NC 29591–8208, Telephone 919-737-3711.

Reith Carolina State University is an equal opportunity/offirmative action employeer. portunity/affirmative action employer.

Sedimentary Petrologia/Wright State University.

The Department of Geological Sciences invites applications for a return track position in sedimentary petrology, at the assistant professor level beginning September 1, 1987. Candidates must have an interest in ratibogate rocks and have analysis. Preference will be given to people rapable of teaching introductory paleonthlogy. The Department has a large MS program and wishes to expand his sedimentary petrology group. Applicants double expect to enople all requirements for the Ph.D. in geological sciences or related field by September 1, 1985. Send resume and these lenters of reference to Chairman, Search Committee, Department of Evological Sciences, 260 firefun Laborature, Wright State University, Dayton, Ohlio 45/35. Closing date for applications is January 15, 1985.

January 15, 1985. Wright State University is accepted upportunally

Opportunities for Gradunte Studies in Atmospheric Sciences at the Georgin Institute of Technology. Openings are available for unitstanding indiskinals scriving an M.S. in Ph.R. degree in graduate milles in almospheric sciences. For successful applicants, these positions include Ostine research assistantships with starting calaries tanging from \$8,000 to \$12,5000 (2) months, depending in the degree helig sought and the student's qualification. All tudion and lives are also creeted by the Institute Coundre andia nitures with survivorting documenta-Complete applications with supporting documention about the received invitates than March 15.

Interested stadents should write to: Dr. Honglas D. Placis School of Geophysical Sciences Georgia Institute of Yechtology Adants, GA 30372.

## **Opportunities** in Geophysics

Lockheod Engineering & Mensgement Service Company has Iwo chellenging geophysical positions evetleble in thezerdoue waste site cherecterization for Superfund. You will be involved in helping the netion solve ite hezerdous weste problems while utilizing the islest technology.

Research Position—You have en MS-Geophysics end 4 years' related experience.

Field Position—This position requires e BS or MS in Geophysics se well as 4 years' tield experience with vertous geophysical tech-

It you meet these requirements and seek the chellenges end rewards offered by a company of this stature, send your resume to E. G. Walther, Lockheed Engineering & Menegement Service Company, P.O. Box 15027, Las Vegss, Nevede 89114, or cell 702-798-2187. Lockheed is an equal opportunity. affirmelive action employer.

Lockheed Engineering and Management Services Company, Inc.

Leadership in Technology

Selemologist/Ohio State University. The Department of Geology and Mineralogy. The titin State University, make a position for a visionologist with research interests in trustal geology and tertonics. The air crossed applicant must be prepared to assist in tracking exploration geophysic contests, advanced topin in likelier speciality, conduct research, and supervise graduate audems. Positionoral or industrial experience is desirable. Rank and salary communications with experience and research treatment. Pleasy send applications or nonminus into

or nonmations to:

Dr. Ralph R.D. von Frese
Charman, Searth Commetter
Department of Geology and Mineralogy
The Other Phice State Princessity
Columbus, COL 422-5635 or 422-7221.

Applications of the Associated in the Columbus and the Columbus and the Columbus and Addresses of the Columbus and the Columbus and Addresses of the Columbus and the Columbus and Columbus and

of research interview and the names and and rows of at least three persons whom we may remain for recommendations. The choung date for applications is December 1, 1984; or until position is filled; ap-polarment can be effective as some at theology. 1985. Additional information can be obtained by writing or valling the chainman of the ward com-

mitee.
The Ohio State Philyeralt is an equal opportuni-ntallimmive action employer.

prolifemative as non-employer.

Texas Tech University/Geophysicist of Clastic Sedimentologist. The Department of Geoscientes at Texas Tech University weeks applications for a tenure track position in the helds of geophysis are clastic sedimentology in begin August 1983. Rank and salary will be commensurate with quadications. The Ph.D. is required. Entry-level applicants will be given preference. The principle waspanishility would be to teach both graduate and modergraduate courses in graphysics or repositional systems and sedimentology, higher specially, and introductory geology. The present will be respected to initiate a research program and to differ MS and Ph.B. graduate students. Send a letter of application with complete curriculous vidue and manner of three references, P.O. Hox 4149, TTU, Luddock, TX 73449, Texas Tech is an equal reportunity/affirmative action employer. Applications deadline: January 81 1985.

Geochemistry. The University of California, Davis will fill a permanent, tenure track, farmly position at the antitatin professor level heginning Fall, 1985. Caudidates having inneresta in compare geochemistry and/or the geochemistry of economic deposits are expecially encouraged as apply but other pecialides in geochemistry will be considered. A PhD degree is required. Responsibilities include teaching at the sundergraduate and graduate levels, and research in geochemistry.

Applicants about a submit complete vita, a statement of revearch and teaching intervols and the names of three referees. It adding to apply atom should be directed on It Howard W. Day, Department of Geology, University of California, Ilavis, CA 95616.

The University of California is an equal opportunishy/shirmative action employer.

nity/aftirmative action emplorer.

SERVICES, SUPPLIES, CHURSES, AND ANNOUNCEMENTS

Summer Course in Min-Optical Oceanugraphy,
Forus been interaction of light and platenplankon, light is a key factor in regulating phytoplankton gooks treuty. In these planeton abundance and
composition regulate light personation in co-cash
bater. Triphs include radiative transfer theory, als-

surption and scattering, ocean color remote sensing, invalintement of optical properties of scawater, physical states of invalidation pignicitis, photosynthesis, and physiological latest of optical variability.

Offered 22 July—24 August, 1985 at the Friday Parky Lahwatories, University of Washington, Parky Lahwatories, University of Washington, Parky Lahwatories, University of Washington in 12 students. Contact instructors for information in contactonent:

Or Mary Jone Perry
School of Oceanography, W8-10
University of Washington
Seattle, WA 98195
206-543-2652

or Dr. Kendall Carder
Department of Marine Science
University of South Florido
St. Petersburg, FL 33701
813-893-9130. For information on registration, contact the Fri-ilay Harber Laboratoriss. Apply before Unarch 1985.

Availability of Request for Cooperative Agreement Applications RFA# 1000-A. Acid Ocposition Moultoring Support for Effects Research/U.S. Environmental Protection Agency. Application Retrieved Lancart 18, 1883.

The U.S. Environmental Protection Agency

The U.S. Environmental Protection Agency (E.P.A.), under the National Arid Precipitation Assemble Program (NAPAP), is announcing the availability of limits for local year 1985 for award-limit accommendate. availability of limits for listal year 1985 for awarding a conjurative agreement) to support acid deposition inonintung stations to enhance the results of acid deposition effects studies. The research arcas of primary interest involve studies of acid deposition truchiding ambient air pollution; machanisms and rates of damage to furet ecosystems, calibrated watersheds and building materials. EPA has approximately one million shollars available to award cooperative agreement(s) to support this project. Support for this program may be for a period extending up to fire years. In order to receive a copy of the RFA and lutcher information confact:

Or. Clarice E. Gaybord

Research Grants Staff

Office of Rerearch & Development

Office of Rerearch & Development
U.S. Entironmental Protection Agency
401 M Street, SW
1t'arhington, D.1.: 20460
Telephone 202-382-7475.

STUDENT OPPORTUNITIES

Graduate Tearhing and Research Agristantibly In Musine Environmental Sciences and Coastal Oscanography. Opportunities for graduate study with graduate and research assistantiships available for students increated in NS and PhO degree programs in marine environmental sciencer and coastal acatingraphy. Awards cover inition and academic year supend up to \$7,883. Additional summer support also neutiable up to \$3,000. Writs: Graduats Programs Chainman, Marine Sciences Research Center, SUNY Stum Bronk, Stony Grook, NY 11794.

Gradoute Research Austraniahlps in Geophysica. Instructions with a background in mathematics, physics, engineering, or analysis algebrosy are mynorial to apply for research assistantships in geophysics for the AFS or PhD programs. Apply any should send a cope of their transcript, a statement of their research enterests, and expected date of BS degree, Wige to R. Street, Department of Geology, Rowman Hall, University of Kentucky, Lexington, KY 40006.

DIRECTOR

**Bartol Research Foundation** 

The Bartol Research Foundation, a division of The Franklin Institute of Philadelphia, announces a search for a new Director to succeed Dr. Mar-

lturiot was established by 'the Franklia Institute in 1924 to conduct re-

search in the physical sciences, emphasizing basic research that ranges

from studies of the fundamental laws of anture to lavestigations that mey

he relevant to the siduling of contemporary technological problems. Cur-

rent research programs are in astrophysics, solar-terrestriol physics, cos-

nile mys, purficle physics, combused mater, and nuclear structure. Bertol is tocated on the campus of the University of Delaware in a building

that is shared with the University Physics Department, A joint graduate

program lending to MS and PhD degrees in Physics or Astrophysics is

Qualifications. A sonior research scientist having a broad interest in the

physical sciences and a distinguished research record is sought. The Director must have the cupacity to identify promising research scientists

and areas of research, and the ability to administer a research institute.

Duties. The Director is expected to continue on aelive research program

of his own that is compatible with the mission of Bertot. Administrative

responsibility for programminie, budgetary, and personnel matters at Bar-

tot on behalf of The Franklin Institute is vested in the Director. The Di-

rector works with the scientific sinff of Bartol, composed of faculty, re-

search associates, post-doctoral fellows, and graduate students, in devel-

oping end funding the various research programs. The Director and Bartol

faculty work cooperatively with the Physics Department in the implemen-

Nonlinations and Applications. The Search Committee Invites the nomi-

didates. The setection process witt begin February 15, 1985. The dele of

Seerch Committee Secretary

Bartol Research Foundation

Sharp Laboratory University of Delaware

Newstk, DE 19716.

appointment is flexible. Nominations and applications are encouraged

nation of potential candidates as well as applications from interested can-

tin A. Patterantz who will retire at the end of 1986.

conducted by the combined ficulty.

isilon of the joint graduate program.

from women end members of minority groups.

Correspondence should be directed to:

# UNIVERSITAT BAYREUTH UBT Experimental Geoscientist

At the University of Beyreuth the Bavarian Research institute of Experimental Geo-edences (BRIEG) will be founded. The institute will be stalled end funded in a way that will be adequate to the international reputation avisaged for this institution.

The University of Bayreuth invitee applications from experimental geoscientists of Internetional ecedemic etanding for the position of the director of the BRIEG. The director of the institute will at the same time be a full professor within the faculty of Blology, Chemistry and Geosciencee.

Applicants should be qualified in Experimental Geosciences (high pressures and high temperatures) and willing to angege in interdisciplinary research work.

Successful epplicants should hold a PhD and have a renge of significant publications of high acedamic standard to their credit ("Habilitation"). They should not be olds than 52 years of ags.

Applications with curriculum vitae, diplomas, ellet of publications, off-prints, a eummary of major research and teaching activities should reach the Dean of faculty of Biology, Chemistry end Geosciances not leter than January 31et, 1985.

Addrese: Dekan der Fekultät für Biologie, Chemie und Geowissenscheften der Universität Bayreuth, Postfach 3008, D-8580 Bayreuth.

## Separates

To Order: The order number can be found at the end of each abstract; use all digits when ordering. Only papers with order numbers are available from AGU. Cost: \$3.50 for the first article and \$1,00 for each additional article in the tame nrder, Payment must accompany order. Deposit accounts available.

beunds are the velocities of the observed defracted waves. An arbitrary safertion of layer bound velocities was found to be a suboptimal choice of podel parameter; and not the seatest inversion.

A teado-off curve between poly remaining and solution variance was constructed with constrained solvely parameteristics for excellention of our enablation and solutions with a flyopes musbar of layers. A constrained model with a flyopes musbar of layers. A constrained model with a flyopes musbar solvened data points apprehendly a satisfactory corporate between model testing to average the solution variance. Forstrained models with one layers than observed data points, boxever, an increase the session of the volucity gradient oxide. If model resolution of the volucity gradient oxide, if model resolution to have an over solution variance, a constrained to deel with many more layers this observed data points is therefore the best codel parameters and (on with the (a)-sets inversion probatique.

GOORNYICS, YOL. 64, 61, 12

Send your order to:

American Geophysical Union
2000 Florida Avenue, N.W.

Washington, D.C. 20009

Exploration Geophysics

First rasplis of the wors extension: Sea Stolyent Computer the Physics, Group of Anomalica, P.O. By 3066, 2000 CA Delic, The Subject of the Physics, Group of Anomalica, P.O. By 3066, 2000 CA Delic, The Subject of the Physics, Group of Anomalica, P.O. By 3066, 2000 CA Delic, The Subject of the Physics, Group of Anomalica, P.O. By 3066, 2000 CA Delic, The Subject of the Physics, Group of Anomalica, P.O. By 3066, 2000 CA Delic, The Subject of the Physics, Group of Anomalica, P.O. By 3066, 2000 CA Delic, The Subject of the Physics, Group of Anomalica, P.O. By 3066, 2000 CA Delic, The Subject of the Physics, Group of Anomalica, P.O. By 3066, 2000 CA Delic, The Subject of the Physics, Group of Anomalica, P.O. By 3066, 2000 CA Delic, The Subject of Carlot of Canada and Physics, Group of Anomalica, P.O. By 3066, 2000 CA Delic, The Subject of Carlot of Canada and Physics, Group of Anomalica, P.O. By 3066, 2000 CA Delic, The Subject of Carlot of Canada and Physics, Group of Anomalica, P.O. By 3066, 2000 CA Delic, The Subject of Carlot of Canada and Subject of Carlot of Carlot

ten lings absistedent on state the not rearrant, the short its control to those the control to those the control to the short of the control to the short of the short of the control to the short of the short of the control to the short of the short of

1207